EPA

Form Approved
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Comprehensive Assessment Information Rule

REPORTING FORM

When completed, send this form to:	For Agency Use Only:
Document Processing Center Office of Toxic Substances, TS-790 U.S. Environmental Protection Agency 401 M Street, SW Washington, DC 20460 Attention: CAIR Reporting Office	Date of Receipt: _____ Document Control Number: _____ Docket Number: _____

EPA Form 7710-52

SECTION 1 GENERAL MANUFACTURER, IMPORTER, AND PROCESSOR INFORMATION

PART A GENERAL REPORTING INFORMATION

1.01 This Comprehensive Assessment Information Rule (CAIR) Reporting Form has been completed in response to the Federal Register Notice of..... [1][2] [2][2] [8][8]
mo. day year

CBI

[ ] a. If a Chemical Abstracts Service Number (CAS No.) is provided in the Federal Register, list the CAS No. ..... [0][2][6][4][7][1]-[6][2]-[5]

b. If a chemical substance CAS No. is not provided in the Federal Register, list either (i) the chemical name, (ii) the mixture name, or (iii) the trade name of the chemical substance as provided in the Federal Register.

(i) Chemical name as listed in the rule ..... N/A

(ii) Name of mixture as listed in the rule .... N/A

(iii) Trade name as listed in the rule ..... N/A

c. If a chemical category is provided in the Federal Register, report the name of the category as listed in the rule, the chemical substance CAS No. you are reporting on which falls under the listed category, and the chemical name of the substance you are reporting on which falls under the listed category.

Name of category as listed in the rule ..... N/A

CAS No. of chemical substance ..... [N][A][ ][ ][ ][ ]-[ ][ ]-[ ]

Name of chemical substance ..... N/A

1.02 Identify your reporting status under CAIR by circling the appropriate response(s).

CBI

Manufacturer 1

[ ] Importer 2

Processor ..... (X 3)

X/P manufacturer reporting for customer who is a processor 4

X/P processor reporting for customer who is a processor 5

[ ] Mark (X) this box if you attach a continuation sheet.

1.03 Does the substance you are reporting on have an "x/p" designation associated with it in the above-listed Federal Register Notice?

CBI

[ ]

Yes ..... [X] Go to question 1.04

No ..... [ ] Go to question 1.05

1.04 a. Do you manufacture, import, or process the listed substance and distribute it under a trade name(s) different than that listed in the Federal Register Notice? Circle the appropriate response.

CBI

[ ]

Yes 1

No ..... (2)

b. Check the appropriate box below: N/A

[ ] You have chosen to notify your customers of their reporting obligations

Provide the trade name(s) .... _____

_____

[ ] You have chosen to report for your customers

[ ] You have submitted the trade name(s) to EPA one day after the effective date of the rule in the Federal Register Notice under which you are reporting.

1.05 If you buy a trade name product and are reporting because you were notified of your reporting requirements by your trade name supplier, provide that trade name.

CBI

[ ]

Trade name ..... Dow Voranate 3071

Is the trade name product a mixture? Circle the appropriate response.

Yes 1

(NA) 2

1.06 Certification -- The person who is responsible for the completion of this form must sign the certification statement below:

CBI

[ ]

"I hereby certify that, to the best of my knowledge and belief, all information entered on this form is complete and accurate."

Charles M. Peters		July 6, 1989
NAME	SIGNATURE	DATE SIGNED
President & Chief Operating Officer	(319) 622 - 2714	
TITLE	TELEPHONE NO.	

[ ] Mark (X) this box if you attach a continuation sheet.

1.07 Exemptions From Reporting -- If you have provided EPA or another Federal agency with the required information on a CAIR Reporting Form for the listed substance within the past 3 years, and this information is current, accurate, and complete for the time period specified in the rule, then sign the certification below. You are required to complete section 1 of this CAIR form and provide any information now required but not previously submitted. Provide a copy of any previous submissions along with your Section 1 submission.

CBI

[ ]

"I hereby certify that, to the best of my knowledge and belief, all required information which I have not included in this CAIR Reporting Form has been submitted to EPA within the past 3 years and is current, accurate, and complete for the time period specified in the rule."

N/A NAME	SIGNATURE	DATE SIGNED
TITLE	( ) - TELEPHONE NO.	DATE OF PREVIOUS SUBMISSION

1.08 CBI Certification -- If you have asserted any CBI claims in this report you must certify that the following statements truthfully and accurately apply to all of those confidentiality claims which you have asserted.

CBI

[ ]

"My company has taken measures to protect the confidentiality of the information, and it will continue to take these measures; the information is not, and has not been, reasonably ascertainable by other persons (other than government bodies) by using legitimate means (other than discovery based on a showing of special need in a judicial or quasi-judicial proceeding) without my company's consent; the information is not publicly available elsewhere; and disclosure of the information would cause substantial harm to my company's competitive position."

N/A NAME	SIGNATURE	DATE SIGNED
TITLE	( ) - TELEPHONE NO.	

[ ] Mark (X) this box if you attach a continuation sheet.

PART B CORPORATE DATA

1.09 Facility Identification

CBI Name [A][M][A][N][A][ ][R][E][F][R][I][G][E][R][A][T][I][O][N][ ][I][N][C][ ][ ][ ]

[ ] Address [H][W][Y][ ][2][2][0][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
Street

[A][M][A][N][A][ ]
City

[I][A] [5][2][2][0][4]--[ ][ ][ ][ ]
State Zip

Dun & Bradstreet Number .....[0][0]-[5][2][7]-[7][6][7][8]

EPA ID Number .....IAD.[0][0][0][6][1][0][4][3][6]

Employer ID Number .....Unknown.....[ ][ ][ ][ ][ ][ ][ ][ ]

Primary Standard Industrial Classification (SIC) Code .....[3][6][3][2]

Other SIC Code .....[3][6][3][1]

Other SIC Code .....N/A.....[ ][ ][ ][ ]

U. S. Tax ID No. 0008-93-527

1.10 Company Headquarters Identification

CBI Name [A][M][A][N][A][ ][R][E][F][R][I][G][E][R][A][T][I][O][N][ ][I][N][C][ ][ ][ ]

[ ] Address [H][W][Y][ ][2][2][0][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
Street

[A][M][A][N][A][ ]
City

[I][A] [5][2][2][0][4]--[ ][ ][ ][ ]
State Zip

Dun & Bradstreet Number .....[0][0]-[5][2][7]-[7][6][7][8]

Employer ID Number .....Unknown.....[ ][ ][ ][ ][ ][ ][ ][ ]

U. S. Tax ID NO. 0008-93-527

[ ] Mark (X) this box if you attach a continuation sheet.

1.11 Parent Company Identification

CBI Name [R][A][Y][T][H][E][O][N]_[C][O][M][P][A][N][Y]

[_] Address [1][4][1]_[S][P][R][I][N][G]_[S][T]
Street

[L][E][X][I][N][G][T][O][N]
City

[M][A] [0][2][1][7][3]--[_][_][_][_]
State Zip

Dun & Bradstreet Number .....[0][0]-[1][3][3]-[9][1][5][9]

1.12 Technical Contact

CBI Name [C][I][N][D][Y]_[R][A][S][P][I][L][L][E][R]

[_] Title [E][N][V][I][R][O][N][M][E][N][T][A][L]_[S][P][E][C][I][A][L][I][S][T]

Address [H][W][Y]_[2][2][0]
Street

[A][M][A][N][A]
City

[I][A] [5][2][2][0][4]--[_][_][_][_]
State Zip

Telephone Number .....[3][1][9]-[6][2][2]-[2][1][7][4]

1.13 This reporting year is from ..... [0][1] [8][8] to [1][2] [8][8]
Mo. Year Mo. Year

[_] Mark (X) this box if you attach a continuation sheet.

1.14 Facility Acquired -- If you purchased this facility during the reporting year, provide the following information about the seller: N/A

CBI Name of Seller [__]

[__] Mailing Address [__]
Street

[__]
City

[__][__] [__][__][__][__][__]--[__][__][__][__]
State Zip

Employer ID Number .....[__][__][__][__][__][__][__][__]

Date of Sale .....[__][__] [__][__] [__][__]
Mo. Day Year

Contact Person [__]

Telephone Number .....[__][__][__]-[__][__][__]-[__][__][__][__]

1.15 Facility Sold -- If you sold this facility during the reporting year, provide the following information about the buyer: N/A

CBI Name of Buyer [__]

[__] Mailing Address [__]
Street

[__]
City

[__][__] [__][__][__][__][__]--[__][__][__][__]
State Zip

Employer ID Number .....[__][__][__][__][__][__][__][__]

Date of Purchase .....[__][__] [__][__] [__][__]
Mo. Day Year

Contact Person [__]

Telephone Number .....[__][__][__]-[__][__][__]-[__][__][__][__]

[__] Mark (X) this box if you attach a continuation sheet.

1.16 For each classification listed below, state the quantity of the listed substance that was manufactured, imported, or processed at your facility during the reporting year.

CBI

[ ]

Classification	Quantity (kg/yr)
Manufactured	N/A
Imported	N/A
Processed (include quantity repackaged)	63,000
Of that quantity manufactured or imported, report that quantity:	
In storage at the beginning of the reporting year	N/A
For on-site use or processing	N/A
For direct commercial distribution (including export)	N/A
In storage at the end of the reporting year	N/A
Of that quantity processed, report that quantity:	
In storage at the beginning of the reporting year	17,600
Processed as a reactant (chemical producer)	63,000*
Processed as a formulation component (mixture producer)	N/A
Processed as an article component (article producer)	N/A
Repackaged (including export)	N/A
In storage at the end of the reporting year	13,100

* We react a TDI mixture with polyol to form a solid foam insulation within our product. Per SPI & our supplier this is properly classified as processing as a reactant. However, the final product is an article.

[ ] Mark (X) this box if you attach a continuation sheet.

PART C IDENTIFICATION OF MIXTURES

1.17 Mixture -- If the listed substance on which you are required to report is a mixture or a component of a mixture, provide the following information for each component chemical. (If the mixture composition is variable, report an average percentage of each component chemical for all formulations.)

CBI

[ ]

Component Name	Supplier Name	Average % Composition by Weight (specify precision, e.g., 45% ± 0.5%)
N/A		
	Total	100%

[ ] Mark (X) this box if you attach a continuation sheet.

2.04 State the quantity of the listed substance that your facility manufactured, imported, or processed during the 3 corporate fiscal years preceding the reporting year in descending order.

CBI

[ ] Year ending ..... [1][2] Mo. [8][7] Year

Quantity manufactured ..... -0- kg

Quantity imported ..... -0- kg

Quantity processed ..... 180,000 kg

Year ending ..... [1][2] Mo. [8][6] Year

Quantity manufactured ..... -0- kg

Quantity imported ..... -0- kg

Quantity processed ..... 151,182 kg

Year ending ..... [1][2] Mo. [8][5] Year

Quantity manufactured ..... -0- kg

Quantity imported ..... -0- kg

Quantity processed ..... 132,296 kg

2.05 Specify the manner in which you manufactured the listed substance. Circle all appropriate process types.

CBI

[ ]

N/A

Continuous process 1

Semicontinuous process 2

Batch process 3

[ ] Mark (X) this box if you attach a continuation sheet.

2.06 Specify the manner in which you processed the listed substance. Circle all
CBI appropriate process types.

[ ]

Continuous process 1

Semicontinuous process 2

Batch process ..... (3)

2.07 State your facility's name-plate capacity for manufacturing or processing the listed substance. (If you are a batch manufacturer or batch processor, do not answer this
CBI question.)

[ ]

Manufacturing capacity ..... N/A _____ kg/yr

Processing capacity ..... _____ kg/yr

2.08 If you intend to increase or decrease the quantity of the listed substance manufactured, imported, or processed at any time after your current corporate fiscal year, estimate the increase or decrease based upon the reporting year's production
CBI volume.

[ ]

	Manufacturing Quantity (kg)	Importing Quantity (kg)	Processing Quantity (kg)
Amount of increase	N/A	N/A	-0-
Amount of decrease	N/A	N/A	60%

[ ] Mark (X) this box if you attach a continuation sheet.

2.09 For the three largest volume manufacturing or processing process types involving the listed substance, specify the number of days you manufactured or processed the listed substance during the reporting year. Also specify the average number of hours per day each process type was operated. (If only one or two operations are involved, list those.)

CBI

[ ]

	Days/Year	Average Hours/Day
Process Type #1 (The process type involving the largest quantity of the listed substance.)		
Manufactured	N/A	N/A
Processed	231	8
Process Type #2 (The process type involving the 2nd largest quantity of the listed substance.)		
Manufactured	N/A	--
Processed	N/A	--
Process Type #3 (The process type involving the 3rd largest quantity of the listed substance.)		
Manufactured	N/A	--
Processed	N/A	--

2.10 State the maximum daily inventory and average monthly inventory of the listed substance that was stored on-site during the reporting year in the form of a bulk chemical.

CBI

[ ]

Maximum daily inventory	Not required for TDI	kg
Average monthly inventory		kg

[ ] Mark (X) this box if you attach a continuation sheet.

2.11 Related Product Types -- List any byproducts, coproducts, or impurities present with the listed substance in concentrations greater than 0.1 percent as it is manufactured, imported, or processed. The source of byproducts, coproducts, or impurities means the source from which the byproducts, coproducts, or impurities are made or introduced into the product (e.g., carryover from raw material, reaction product, etc.).

CBI

[ ]

CAS No.	Chemical Name	Byproduct, Coproduct or Impurity[1]	Concentration (%) (specify ± % precision)	Source of Byproducts, Coproducts, or Impurities
Unknown				

[1]Use the following codes to designate byproduct, coproduct, or impurity:

B = Byproduct
C = Coproduct
I = Impurity

[ ] Mark (X) this box if you attach a continuation sheet.

2.12 Existing Product Types -- List all existing product types which you manufactured, imported, or processed using the listed substance during the reporting year. List the quantity of listed substance you use for each product type as a percentage of the total volume of listed substance used during the reporting year. Also list the quantity of listed substance used captively on-site as a percentage of the value listed under column b., and the types of end-users for each product type. (Refer to the instructions for further explanation and an example.)

CBI
[ ]

a. Product Types[1]	b. % of Quantity Manufactured, Imported, or Processed	c. % of Quantity Used Captively On-Site	d. Type of End-Users[2]
b	100	100	N/A

[1]Use the following codes to designate product types:

A = Solvent
B = Synthetic reactant
C = Catalyst/Initiator/Accelerator/Sensitizer
D = Inhibitor/Stabilizer/Scavenger/Antioxidant
E = Analytical reagent
F = Chelator/Coagulant/Sequestrant
G = Cleanser/Detergent/Degreaser
H = Lubricant/Friction modifier/Antiwear agent
I = Surfactant/Emulsifier
J = Flame retardant
K = Coating/Binder/Adhesive and additives
L = Moldable/Castable/Rubber and additives
M = Plasticizer
N = Dye/Pigment/Colorant/Ink and additives
O = Photographic/Reprographic chemical and additives
P = Electrodeposition/Plating chemicals
Q = Fuel and fuel additives
R = Explosive chemicals and additives
S = Fragrance/Flavor chemicals
T = Pollution control chemicals
U = Functional fluids and additives
V = Metal alloy and additives
W = Rheological modifier
X = Other (specify) _____

[2]Use the following codes to designate the type of end-users:

I = Industrial
CM = Commercial
CS = Consumer
H = Other (specify) _____

[ ] Mark (X) this box if you attach a continuation sheet.

2.13 Expected Product Types -- Identify all product types which you expect to manufacture, import, or process using the listed substance at any time after your current corporate fiscal year. For each use, specify the quantity you expect to manufacture, import, or process for each use as a percentage of the total volume of listed substance used during the reporting year. Also list the quantity of listed substance used captively on-site as a percentage of the value listed under column b., and the types of end-users for each product type. (Refer to the instructions for further explanation and an example.)

CBI
[ ]

a. Product Types[1]	b. % of Quantity Manufactured, Imported, or Processed	c. % of Quantity Used Captively On-Site	d. Type of End-Users[2]
b	100	100	N/A

[1]Use the following codes to designate product types:

A = Solvent
B = Synthetic reactant
C = Catalyst/Initiator/Accelerator/Sensitizer
D = Inhibitor/Stabilizer/Scavenger/Antioxidant
E = Analytical reagent
F = Chelator/Coagulant/Sequestrant
G = Cleanser/Detergent/Degreaser
H = Lubricant/Friction modifier/Antiwear agent
I = Surfactant/Emulsifier
J = Flame retardant
K = Coating/Binder/Adhesive and additives
L = Moldable/Castable/Rubber and additives
M = Plasticizer
N = Dye/Pigment/Colorant/Ink and additives
O = Photographic/Reprographic chemical and additives
P = Electrodeposition/Plating chemicals
Q = Fuel and fuel additives
R = Explosive chemicals and additives
S = Fragrance/Flavor chemicals
T = Pollution control chemicals
U = Functional fluids and additives
V = Metal alloy and additives
W = Rheological modifier
X = Other (specify) _____

[2]Use the following codes to designate the type of end-users:

I = Industrial
CM = Commercial
CS = Consumer
H = Other (specify) _____

[ ] Mark (X) this box if you attach a continuation sheet.

2.14 Final Product -- Complete the following table for each type of final product
CBI manufactured, imported, or processed at your facility that contains the listed substance other than as an impurity.

[ ]

a. Product Type[1]	b. Final Product's Physical Form[2]	c. Average % Composition of Listed Substance in Final Product	d. Type of End-Users[3]
N/A			

[1]Use the following codes to designate product types:

A = Solvent
B = Synthetic reactant
C = Catalyst/Initiator/Accelerator/ Sensitizer
D = Inhibitor/Stabilizer/Scavenger/ Antioxidant
E = Analytical reagent
F = Chelator/Coagulant/Sequestrant
G = Cleanser/Detergent/Degreaser
H = Lubricant/Friction modifier/Antiwear agent
I = Surfactant/Emulsifier
J = Flame retardant
K = Coating/Binder/Adhesive and additives
L = Moldable/Castable/Rubber and additives
M = Plasticizer
N = Dye/Pigment/Colorant/Ink and additives
O = Photographic/Reprographic chemical and additives
P = Electrodeposition/Plating chemicals
Q = Fuel and fuel additives
R = Explosive chemicals and additives
S = Fragrance/Flavor chemicals
T = Pollution control chemicals
U = Functional fluids and additives
V = Metal alloy and additives
W = Rheological modifier
X = Other (specify) _____

[2]Use the following codes to designate the final product's physical form:

A = Gas
B = Liquid
C = Aqueous solution
D = Paste
E = Slurry
F1 = Powder
F2 = Crystalline solid
F3 = Granules
F4 = Other solid
G = Gel
H = Other (specify) _____

[3]Use the following codes to designate the type of end-users:

I = Industrial
CM = Commercial
CS = Consumer
H = Other (specify) _____

[ ] Mark (X) this box if you attach a continuation sheet.

2.15 Circle all applicable modes of transportation used to deliver bulk shipments of the
CBI listed substance to off-site customers.

[ ] Truck ..... N/A 1

Railcar 2

Barge, Vessel 3

Pipeline 4

Plane 5

Other (specify) _____ 6

2.16 Customer Use -- Estimate the quantity of the listed substance used by your customers or prepared by your customers during the reporting year for use under each category
CBI of end use listed (i-iv). N/A

[ ]

Category of End Use

i. Industrial Products

Chemical or mixture ..... _____ kg/yr

Article ..... _____ kg/yr

ii. Commercial Products

Chemical or mixture ..... _____ kg/yr

Article ..... _____ kg/yr

iii. Consumer Products

Chemical or mixture ..... _____ kg/yr

Article ..... _____ kg/yr

iv. Other

Distribution (excluding export) ..... _____ kg/yr

Export ..... _____ kg/yr

Quantity of substance consumed as reactant ..... _____ kg/yr

Unknown customer uses ..... _____ kg/yr

[ ] Mark (X) this box if you attach a continuation sheet.

SECTION 3 PROCESSOR RAW MATERIAL IDENTIFICATION

PART A GENERAL DATA

3.01 Specify the quantity purchased and the average price paid for the listed substance for each major source of supply listed. Product trades are treated as purchases.
CBI The average price is the market value of the product that was traded for the listed substance.
[ ]

Source of Supply	Quantity (kg)	Average Price ($/kg)
The listed substance was manufactured on-site.	N/A	--
The listed substance was transferred from a different company site.	N/A	--
The listed substance was purchased directly from a manufacturer or importer.	63,000	.43
The listed substance was purchased from a distributor or repackager.	N/A	--
The listed substance was purchased from a mixture producer.	N/A	--

3.02 Circle all applicable modes of transportation used to deliver the listed substance to
CBI your facility.
[ ]

Truck ..... (1)
Railcar 2
Barge, Vessel 3
Pipeline 4
Plane 5
Other (specify) _____ 6

[ ] Mark (X) this box if you attach a continuation sheet.

3.03 CBI a. Circle all applicable containers used to transport the listed substance to your facility.

[ ]

Bags 1

Boxes 2

Free standing tank cylinders 3

Tank rail cars 4

Hopper cars 5

Tank trucks ..... (6)

Hopper trucks 7

Drums ..... (8)

Pipeline 9

Other (specify) _____ 10

b. If the listed substance is transported in pressurized tank cylinders, tank rail cars, or tank trucks, state the pressure of the tanks.

Tank cylinders ..... N/A mmHg

Tank rail cars ..... N/A mmHg

Tank trucks ..... 414 mmHg

[ ] Mark (X) this box if you attach a continuation sheet.

PART B RAW MATERIAL IN THE FORM OF A MIXTURE

3.04 If you obtain the listed substance in the form of a mixture, list the trade name(s) of the mixture, the name of its supplier(s) or manufacturer(s), an estimate of the CBI average percent composition by weight of the listed substance in the mixture, and the amount of mixture processed during the reporting year.

[ ]

Trade Name	Supplier or Manufacturer	Average % Composition by Weight (specify ± % precision)	Amount Processed (kg/yr)
N/A			

[ ] Mark (X) this box if you attach a continuation sheet.

PART C RAW MATERIAL VOLUME

3.05 CBI [ ] State the quantity of the listed substance used as a raw material during the reporting year in the form of a class I chemical, class II chemical, or polymer, and the percent composition, by weight, of the listed substance.

	Quantity Used (kg/yr)	% Composition by Weight of Listed Substance in Raw Material (specify ± % precision)
Class I chemical	63,000	60*
Class II chemical	N/A	
Polymer	N/A	

* % precision unknown

[ ] Mark (X) this box if you attach a continuation sheet.

SECTION 4 PHYSICAL/CHEMICAL PROPERTIES

General Instructions:

If you are reporting on a mixture as defined in the glossary, reply to questions in Section 4 that are inappropriate to mixtures by stating "NA -- mixture."

For questions 4.06-4.15, if you possess any hazard warning statement, label, MSDS, or other notice that addresses the information requested, you may submit a copy or reasonable facsimile in lieu of answering those questions which it addresses.

PART A PHYSICAL/CHEMICAL DATA SUMMARY

4.01 Specify the percent purity for the three major[1] technical grade(s) of the listed substance as it is manufactured, imported, or processed. Measure the purity of the substance in the final product form for manufacturing activities, at the time you import the substance, or at the point you begin to process the substance.

CBI

[ ]

	Manufacture	Import	Process
Technical grade #1	N/A % purity	N/A % purity	60 % purity*
Technical grade #2	____ % purity	____ % purity	____ % purity
Technical grade #3	____ % purity	____ % purity	____ % purity

*Material we buy is 60% TDI, with the balance prepolymers. We have attached the MSDS.

[1]Major = Greatest quantity of listed substance manufactured, imported or processed.

4.02 Submit your most recently updated Material Safety Data Sheet (MSDS) for the listed substance, and for every formulation containing the listed substance. If you possess an MSDS that you developed and an MSDS developed by a different source, submit your version. Indicate whether at least one MSDS has been submitted by circling the appropriate response.

Yes ..Attachment One..... 1

No 2

Indicate whether the MSDS was developed by your company or by a different source.

Your company 1

Another source 2

[ ] Mark (X) this box if you attach a continuation sheet.

MATERIAL SAFETY DATA SHEET

Dow Chemical U.S.A.* Midland, MI 48674 Emergency Phone: 517-636-4400

PRODUCT NAME: VORANATE (R) 3071 ISOCYANATE

Effective Date: 12/27/88 Date Printed: 02/22/89 MSDS:001138

1. INGREDIENTS: (% w/w, unless otherwise noted)

Toluene Diisocyanate (TDI)	CAS# 026471-62-5	60%
Prepolymer of TDI and propoxylated glycerine	CAS# 039279-01-1	10-30%
Prepolymer of TDI and propoxylated sucrose	CAS# 059154-64-2	10-30%

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

2. PHYSICAL DATA:

BOILING POINT: 480F, 249C
VAP PRESS: .04 mmHg @ 75F, 24C
VAP DENSITY: 6.00
SOL. IN WATER: Reacts
SP. GRAVITY: Approx. 1.27 @ 25/4C
APPEARANCE: Clear brown liquid
ODOR: Very sharp, pungent odor.

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: 260F, 127C
METHOD USED: PMCC, ASTM D93

FLAMMABLE LIMITS
LFL: Not determined

UFL: Not determined

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, or foam. If water is used, it should be in very large quantity. The reaction between water and hot isocyanate may be vigorous.

(Continued on Page 2)

* An Operating Unit of The Dow Chemical Company

ATTACHMENT ONE

3. FIRE AND EXPLOSION HAZARD DATA: (CONTINUED)

FIRE & EXPLOSION HAZARDS: Down-wind personnel must be evacuated. Do not reseal contaminated containers since pressure build-up may cause rupture.

FIRE-FIGHTING EQUIPMENT: People who are fighting isocyanate fires must be protected against nitrogen oxide fumes and isocyanate vapors by wearing positive pressure self-contained breathing apparatus and full protective clothing.

4. REACTIVITY DATA:

STABILITY: (CONDITIONS TO AVOID) Stable when stored under recommended storage conditions. Store in a dry place at temperatures between 15-38C (60-100F).

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) Water, acid, base, alcohols, metal compounds, surface active materials. Avoid water as it reacts to form heat, CO2 and insoluble urea. The combined effect of the CO2 and heat can produce enough pressure to rupture a closed container.

HAZARDOUS DECOMPOSITION PRODUCTS: Isocyanate vapor and mist, carbon dioxide, carbon monoxide, nitrogen oxides and traces of hydrogen cyanide.

HAZARDOUS POLYMERIZATION: May occur with incompatible reactants, especially strong bases, water or temperatures over 49C (120F).

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

ACTION TO TAKE FOR SPILLS/LEAKS:

Evacuate and ventilate spill area, dike spill to prevent entry into water system, wear full protective equipment including respiratory equipment during clean up.

(Continued on Page 3)

5. ENVIRONMENTAL AND DISPOSAL INFORMATION: (CONTINUED)

Major spill: Call Dow Chemical U.S.A. (409) 238-2112. If transportation spill involved call CHEMTREC (800) 424-9300. If temporary control of isocyanate vapor is required a blanket of protein foam (available at most fire departments) may be placed over the spill. Large quantities may be pumped into closed but not sealed containers for disposal.

Minor spill: Absorb the isocyanate with sawdust or other absorbent and shovel into open top containers. Do not make pressure tight. Transport to a well-ventilated area (outside) and treat with neutralizing solution consisting of a mixture of water and 3-8% concentrated ammonium hydroxide or 5-10% sodium carbonate. Add about 10 parts of neutralizer per part of isocyanate with mixing. Allow to stand for 48 hours letting evolved carbon dioxide to escape.

Clean-up: Decontaminate floor using water/ammonia solution with 1-2% added detergent letting stand over affected area for at least 10 minutes. Cover mops and brooms used for this with plastic and dispose properly (often by incineration).

DISPOSAL METHOD: Follow all federal, state and local regulations. Liquids are usually incinerated in a proper facility. Solids are usually also incinerated or landfilled. Empty drums should be filled with water. Let drum stand unsealed for 48 hours. Before disposal drums should be drained, triple rinsed, and holed to prevent reuse. Dispose of drain and rinse fluid according to federal, state and local laws and regulations. The most commonly accepted method is in an approved wastewater treatment facility. Drums should be disposed of in accordance with federal, state and local laws and regulations. Commonly accepted methods for disposal of plastic drums are disposal in an approved landfill after shredding or incineration in an approved industrial incinerator or other appropriate incinerator facility. Steel drums are commonly disposed in an approved landfill after crushing or in accordance with other approved procedures.

(Continued on Page 4)

6. HEALTH HAZARD DATA:

EYE: May cause pain and severe irritation with corneal injury. In animals, irritation and corneal injury healed within 21 days.

SKIN CONTACT: Prolonged or repeated exposure may cause skin irritation. Skin contact may result in allergic reaction even though it is not expected to result in absorption of amounts sufficient to cause other adverse effects.

SKIN ABSORPTION: The dermal LD50 has not been determined.

INGESTION: Single dose oral toxicity is low. The oral LD50 for rats is >4000 mg/kg. Ingestion may cause gastrointestinal irritation or ulceration.

INHALATION: Excessive vapor concentrations are attainable and could be hazardous on single exposure. Single and repeated excessive exposure may cause severe irritation to upper respiratory tract and lungs (choking sensation, chest tightness), respiratory sensitization, decreased ventilatory capacity, liver effects, cholinesterase depression, gastro-intestinal distress and/or neurologic disorders. The 4-hour LC50 for TDI for rats is 13.9 ppm.

SYSTEMIC & OTHER EFFECTS: This mixture contains a component which is listed as a potential carcinogen for hazard communication purposes under OSHA standard 29 CFR 1910.1200 (TDI, listed by NTP and IARC). An oral study in which high doses of TDI were reported to cause cancer in animals has been found to contain numerous deficiencies which compromise the validity of the study. TDI did not cause cancer in laboratory animals exposed by inhalation, the most likely route of exposure. Birth defects are unlikely from exposure to the TDI componenet. Exposures having no effect on the mother should have no effect on the mother should have no effect on the fetus. TDI did not cause birth defects in animals; slight effects were seen in the fetus but only at doses which caused toxic effects to the mother. Results of in vitro ("test tube") mutagenicity tests have been inconclusive.

(Continued on Page 5)

7. FIRST AID:

EYES: Irrigate with flowing water immediately and continuously for 15 minutes. Consult medical personnel.

SKIN: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician if irritation persists. Wash clothing before reuse. Destroy contaminated shoes.

INGESTION: Do not induce vomiting. Call a physician and/or transport to emergency facility immediately.

INHALATION: Remove to fresh air. If not breathing, give mouth-to-mouth resuscitation. If breathing is difficult, give oxygen. Call a physician.

NOTE TO PHYSICIAN: May cause tissue destruction leading to stricture. If lavage is performed, suggest endotracheal and/or esophagoscopic control. If burn is present, treat as any thermal burn, after decontamination. No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient. The manifestations of reactions of the patient. The manifestations of the respiratory symptoms, including pulmonary edema, resulting from acute exposure may be delayed. May cause respiratory sensitization. Cholinesterase inhibition has been noted in human exposure but is not of benefit in determining exposure and is not correlated with signs of exposure.

8. HANDLING PRECAUTIONS:

EXPOSURE GUIDELINE(S): OSHA PEL is 0.02 ppm as a ceiling limit for toluene 2,4-diisocyanate. ACGIH TLV is 0.005 ppm; 0.02 ppm STEL for toluene 2,4-diisocyanate. Dow Industrial Hygiene Guide is 0.02 ppm as a ceiling limit for toluene diisocyanate.

VENTILATION: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

(Continued on Page 6)

8. HANDLING PRECAUTIONS: (CONTINUED)

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required for certain operations, use an approved supplied-air respirator. For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved positive-pressure self-contained breathing apparatus.

SKIN PROTECTION: Use protective clothing impervious to this material. Selection of specific items such as gloves, boots, apron, or full-body suit will depend on operation. Remove contaminated clothing immediately, wash skin area with soap and water, and launder clothing before reuse. Safety shower should be located in immediate work area.

EYE PROTECTION: Use chemical goggles. If vapor exposure causes eye irritation, use a full-face, supplied-air respirator. Eye wash fountain should be located in immediate work area.

9. ADDITIONAL INFORMATION:

REGULATORY REQUIREMENTS:

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA 'Hazard Categories' promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard
A reactive hazard

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Prevent all contact; warning properties of this material (irritation of eyes, nose, and throat) are not adequate to prevent chronic

(Continued on Page 7)

9. ADDITIONAL INFORMATION: (CONTINUED)

overexposure from inhalation. This material can produce asthmatic sensitization upon either single inhalation exposure to a relatively high concentration or upon repeated inhalation exposure to lower concentrations. Exposures to vapors of heated TDI can be extremely dangerous.

MSDS STATUS: Revised Sections 1, 3, 5, 6, and 7.

SARA 313 INFORMATION:
This product contains the following substances subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372:

CHEMICAL NAME	CAS NUMBER	CONCENTRATION
TOLUENE-2,6-DIISOCYANATE	000091-08-7	<60 %
TOLUENE-2,4-DIISOCYANATE	000584-84-9	<60 %

4.03 Submit a copy or reasonable facsimile of any hazard information (other than an MSDS) that is provided to your customers/users regarding the listed substance or any formulation containing the listed substance. Indicate whether this information has been submitted by circling the appropriate response.

Yes ..... Attachment Two and Three 1X

No 2

4.04 For each activity that uses the listed substance, circle all the applicable number(s) corresponding to each physical state of the listed substance during the activity listed. Physical states for importing and processing activities are determined at the time you import or begin to process the listed substance. Physical states for manufacturing, storage, disposal and transport activities are determined using the final state of the product.

CBI

[ ]

Activity		Physical State				
		Solid	Slurry	Liquid	Liquified Gas	Gas
Manufacture	N/A	1	2	3	4	5
Import	N/A	1	2	3	4	5
Process		1	2	3X	4	5
Store		1X	2	3X	4	5
Dispose *		1X	2	3X	4	5
Transport		1X	2	3X	4	5

* No material is disposed of on site. However, both solid and liquid TDI are transferred off site for incineration.

[ ] Mark (X) this box if you attach a continuation sheet.

VORANATE T-80 Toluene Diisocyanates

Unloading Procedures

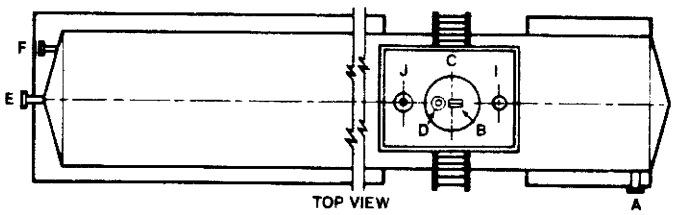
Tank Trucks Unloading Procedures

VORANATE* T-80 Toluene Diisocyanates are classified as hazardous materials under the Department of Transportation's "Hazardous Material Regulations." The unloading of tank trucks, therefore, must be done in strict accordance with those regulations. Some, but not all, of those regulations are described below.

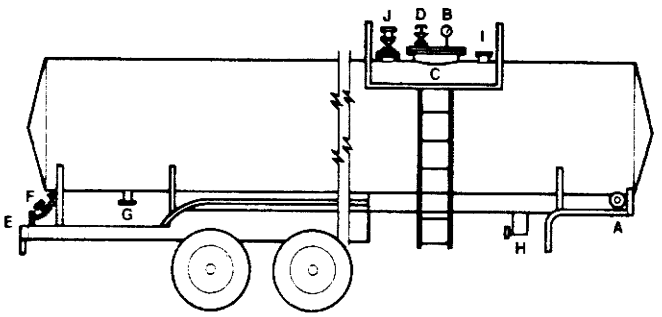
VORANATE T-80 Toluene Diisocyanates are shipped in pressurized and insulated stainless steel tank trucks, equipped for bottom unloading only. Dow recommends that only DOT specification MC304 or 307 tank trucks be used. CAUTION: Only properly trained and equipped personnel are permitted to unload tank trucks. Operators should wear an approved respiratory protective device and protective clothing, footwear, and gloves. For a detailed discussion of health hazards and safe handling procedures, see the Dow bulletin, *Safe Handling and Storage of VORANATE T-80 Toluene Diisocyanates* (Form No. 109-561-288).

Tank Truck Trailer

A — ¾" Steam Inlet
B — 35# Safety Valve and Pressure Gauge
C — Manhole
D — ¾" Dry air/Nitrogen Connection
E — 3" Unloading Connection
F — ½" Sample Valve
G — Steam Outlet
H — Air Dryer
I — 2" Loading Line
J — 2" Vent Line



TOP VIEW



SIDE VIEW

THE DOW CHEMICAL COMPANY • PLASTICS GROUP • MIDLAND, MI 48674

Printed in U.S.A.

*Trademark of The Dow Chemical Company

Form No. 109-561A-288 SMG
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ATTACHMENT TWO

Read and follow carefully each of the safety recommendations and precautions listed below:

1 Before attempting to use the following procedure operators should be thoroughly familiar with the potential hazards associated with the handling and storage of TDI.

2 Position the trailer as level as possible and block the wheels.

3 Carefully check the storage tank into which the contents of the truck are to be unloaded to be certain that it contains the intended VORANATE T-80 Toluene Diisocyanate product and *not* some other chemical or compound. Also, check the gauge on the storage tank to be sure that there is sufficient room to receive the entire contents of the tank truck.

4 Check all "product identification" or "bulk" tags (usually attached to product outlets, valves, or seals) to be certain that the product being unloaded is, in fact, the intended VORANATE T-80 Toluene Diisocyanate.

5 Check the temperature of the contents. The temperature must be *above* 60°F (16°C) when the trailer is unloaded.

6 If heating is required, attach a 25 psi steam supply to the heating coil inlet connection. For better control of the heating process, use a steam pressure of 15 psi. Attach a steam trap, designed for the steam pressure available, to the heating coil outlet connection. Internal coils are not advised because of severe effects due to possible water contamination of the product. Allow the contents to warm until the temperature is at least 68°F (20°C). When the temperature reaches 68°F (20°C), turn off the steam and disconnect the lines. To prevent the heating coils from freezing during cold weather, be sure to drain them or "blow them out." CAUTION: Carefully watch the thermometer during heating. Do *not* allow the temperature to rise above 104°F (40°C).

7 Attach the unloading line. The line should be clean, dry, and preferably made of flexible metal or either Teflon† fluorocarbon or Viton† fluoroelastomer hose which can safely withstand unloading pressures.

8 Connect the dry purge gas (preferably nitrogen) line to the tank truck. This line should have a pressure gauge, a safety valve set at 30 psig, and a pressure regulator set at 25 psig.

9 Draw off a sample of the contents for analysis. A sample of the contents may be obtained by connecting stainless steel tubing to the sample connection. Flush the sample connection by drawing off at least one gallon of product into a clean, dry container. The sample to be analyzed may now be drawn off into another clean, dry container of whatever size is necessary for testing. **WARNING:** Do *not* breathe vapors. Wear proper protective equipment whenever there is *any* possibility of contact with isocyanate liquid or vapors.

10a *If the contents are to be unloaded by purge gas pressure alone*, the storage tank should be fitted with a vent scrubber. This will prevent vapors from being vented into the atmosphere during unloading. (CAUTION: Do *not* exceed 25 psig purge gas pressure to unload the tank truck.) When the tank truck is empty, the pressure gauge will show a drop in pressure. Close the valve at the storage tank connection *first*. Then close the truck unloading valve.

10b *If the contents are to be unloaded by pump*, either a vapor line connecting the storage tank vent to the tank truck should be installed (closed loop) or a low-pressure, replenishable gas pad must be placed on the tank truck. If a gas pad is used, install a vent scrubber on the storage tank vent. These precautions will not only prevent isocyanate vapors from being vented to the atmosphere, but will prevent a vacuum from being pulled on the tank truck during unloading. (CAUTION: Do *not* use a closed loop system unless the dead air space in the storage tank is free of moisture; i.e., −40°F (−40°C) dew point. Also, connection hoses should be purged with dry air or nitrogen before hookup.) When the trailer is empty, allow the unloading hose to vent down to the storage tank. Be sure to close the valve at the storage tank connection *first*. Then close the tank truck unloading valve.

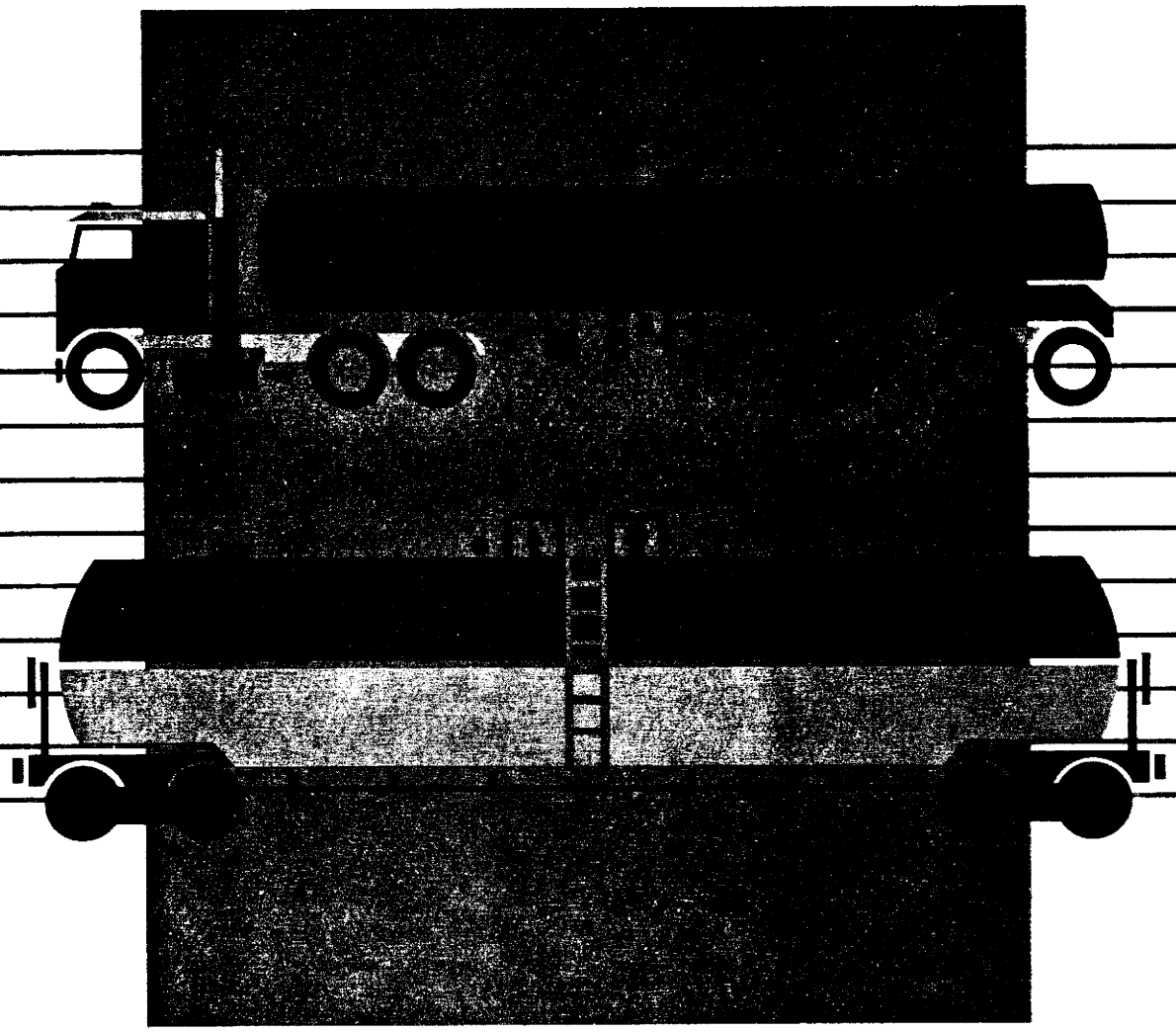
11 Shut off the purge gas to the tank truck. Close the tank truck purge gas valve and disconnect the purge gas line. If a closed loop system was used in conjunction with pump unloading, close the tank truck connection valve and the tank vent valve. Then disconnect the hose connecting the two. All connection hoses should now be cleaned, dried, and capped for storage.

CAUTION: Unloading must be *closely monitored*, particularly if there is no automatic "cutoff" in the unloading line. For example, if gas flow is allowed to continue after unloading, the gas flowing into the storage tank could rapidly increase internal pressure. This could cause serious structural damage to the storage vessel.

The tank truck should *not* be cleaned by the customer nor should the manway be opened for inspection. The cleaning and inspection of the tank truck should be handled by the shipper under carefully controlled conditions designed to safeguard personnel and equipment. **WARNING:** Under no circumstances should personnel enter any "empty" tank truck.

†Trademarks and products of E. I. du Pont de Nemours Co., Inc.

Safe Handling and Storage of VORANATE T-80 Toluene Diisocyanates



ATTACHMENT THREE

Safe Handling and Storage of VORANATE T-80 Toluene Diisocyanates

- A mixture of the 2,4- and 2,6-isomers of toluene diisocyanate in a ratio, by weight, of 80 to 20 percent.
- Available in both high- and low-acidity grades.
- Produced in accordance with exacting standards of product purity and quality.
- Widely used in a broad range of industrial applications, including the production of flexible polyurethane foams for furniture, bedding, and automotive seating and padding.
- Also used in the production of elastomers, coatings, adhesives, semi-flexible foams, and carpet underlayment and backing.
- Manufactured and marketed by The Dow Chemical Company — a leading supplier of quality products and services to the polyurethane industry.

Contents

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This publication was printed in February 1988. Since The Dow Chemical Company is continually updating its product safety and handling information, please contact Dow for updated information or revisions to this bulletin if a significant period of time has passed since the publication date.

VORANATE T-80
Safe Handling and Storage

VORANATE T-80 Toluene Diisocyanates

VORANATE* T-80 Type I Toluene Diisocyanate and VORANATE T-80 Type II Toluene Diisocyanate are two members of a family of quality isocyanate products manufactured and marketed by The Dow Chemical Company. These products are a mixture of the 2,4- and 2,6-isomers of toluene diisocyanate (TDI) in a ratio, by weight, of 80 to 20 percent. Type I is a low-acidity grade and Type II is a high-acidity grade. Both products are produced in accordance with exacting standards of quality and product purity.

VORANATE T-80 Toluene Diisocyanates are widely used in a variety of industrial applications, including the production of flexible polyurethane foams for use in furniture, bedding, and automotive applications. They are also widely used in the production of elastomers, coatings, adhesives, semi-flexible foams, and carpet underlayment and backing.

A second group of quality isocyanate products — VORANATE Specialty Isocyanates — is manufactured and marketed by The Dow Chemical Company, primarily for use in the production of "rigid" polyurethane foams, which are used by the home appliance industry to insulate refrigerators, freezers, and water heaters. These materials are also widely used in such rigid foam applications and products as rigid foam insulation, "spray up" or "spray on" foam insulation, wood simulation products, and various other structural items. VORANATE Specialty Isocyanates are discussed in detail in the Dow bulletin, *Safe Handling and Storage of VORANATE Specialty Isocyanates* (Form No. 109-546-82), copies of which are available upon request from any Dow sales office or The Dow Chemical Company, Plastics Group, 2040 Willard H. Dow Center, Midland, MI 48674.

VORANATE T-80 Toluene Diisocyanates are hazardous materials which must be handled and stored only by knowledgeable and experienced personnel who are thoroughly familiar with the hazards associated with their shipment, storage, distribution, and use.

The purpose of this booklet is to inform customers of the hazards associated with VORANATE T-80 Toluene Diisocyanates — particularly the hazards of inhaling TDI vapors and the possible explosive rupture of restricted lines and vessels caused by product contamination and the subsequent formation of carbon dioxide gas — and to outline in detail those practices and procedures which have been developed to assist in their safe storage and handling. In short: "Chemicals in any form can be safely stored, handled, or used if the physical, chemical, and hazardous properties are fully understood and the necessary precautions, including the use of proper safeguards and personal protective equipment, are observed."[1]

WARNING

VORANATE T-80 Toluene Diisocyanates are hazardous materials which ***must*** *be handled, used, and stored with extreme care and in strict compliance with the safety recommendations and precautions outlined on the product label and described in this booklet.*

Note: The recommendations contained in this booklet are based on the results of numerous tests and on actual experiences in the field, and are believed to be accurate and reliable. However, since the specific circumstances associated with a customer's use of VORANATE T-80 Toluene Diisocyanates are unknown to The Dow Chemical Company and are beyond its control, the company cannot guarantee that adherence to these recommendations will insure absolute safety. Inquiries about specific operations and procedures or about matters relating to the safe use, handling, and storage of VORANATE T-80 Toluene Diisocyanates may be addressed to The Dow Chemical Company, Plastics Group, 2040 Willard H. Dow Center, Midland, MI 48674.

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[1]Quoted from a publication of the Chemical Manufacturers Association.

PART ONE

Properties, Handling Precautions, and Industrial Hygiene

Properties

Table 1 — Typical Physical Properties: VORANATE T-80 Toluene Diisocyanates

Properties[1]	Values
Molecular Weight	174.2
Physical Form	Colorless to Pale Yellow Liquid
Odor	Very Sharp and Pungent
Density (@ 20°C), lbs/gal	10.2
Specific Gravity (25°C/25°C)	1.22
Boiling Point at 10 mm Hg	248°F (120°C)
at 760 mm Hg	482°F (250°C)
Viscosity @ 77°F (25°C) cst	2.5
Freezing Point	57°F (14°C)
Flash Point	
Cleveland Open Cup	270°F (132°C)
Pensky-Martens Closed Cup	260°F (127°C)
Tag Open Cup	270°F (132°C)
Fire Point	
Cleveland Open Cup	295°F (146°C)[2]
Refractive Index @ 77°F (25°C)	1.5662
Specific Heat, Btu/lb, °F	0.35 @ 68°F
	0.41 @ 212°F
Specific Heat, cal/gram, °C	0.35 @ 20°C
	0.41 @ 100°C
Heat of Evaporation	Btu/lb cal/g
@ 250°F (121°C)	131 73
@ 355°F (197°C)	121 67
Decomposition Temperature	530°F (287°C)
Vapor Density (Air = 1)	6.0
Vapor Pressure @ 77°F (25°C), mm Hg	0.01

[1]Typical properties; not to be construed as specifications.

[2]Results of small scale tests are not intended to reflect behavior of this or any other material under actual fire conditions.

Table 2 — Specifications: VORANATE T-80 Toluene Diisocyanates

Properties	Type I Low Acidity Grade	Type II High Acidity Grade
Assay (wt % TDI) min	99.5	99.5
Acidity (wt % HCl) limits	0.0010-0.0040	0.0070-0.0120
Hydrolyzable Chloride (wt %) limits	0.0015-0.0070	0.0070-0.0150
Total Chloride (wt %) max	0.06	0.07
Color (APHA) max	25	25
Isomer Content,		
% 2,4 Isomer	79-81	79-81
% 2,6 Isomer	19-21	19-21

Method of analysis for data is ASTM D1638-70. Copies of ASTM D1638-70 can be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

Figure 1 — Density vs. Temperature of VORANATE T-80 TDI

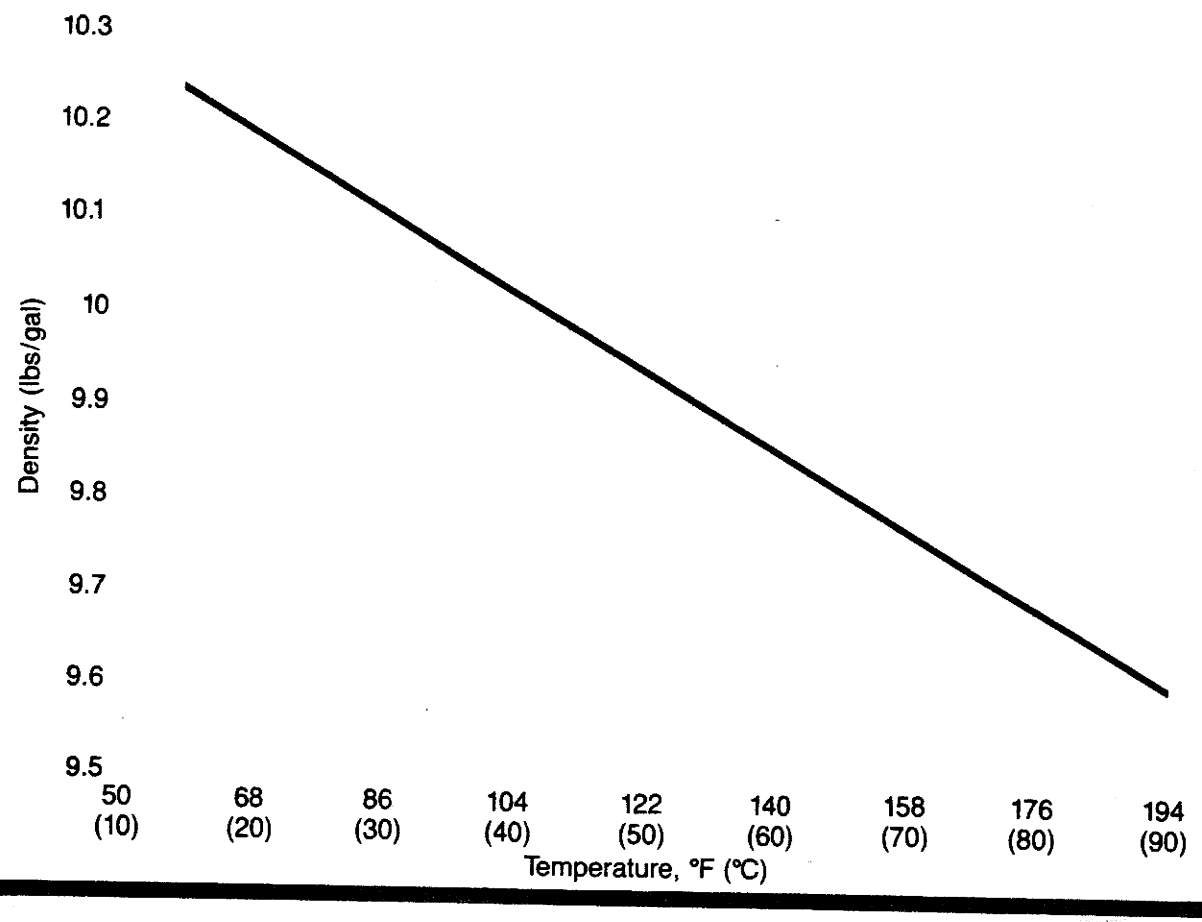


Figure 2 — Viscosity vs. Temperature of VORANATE T-80 TDI

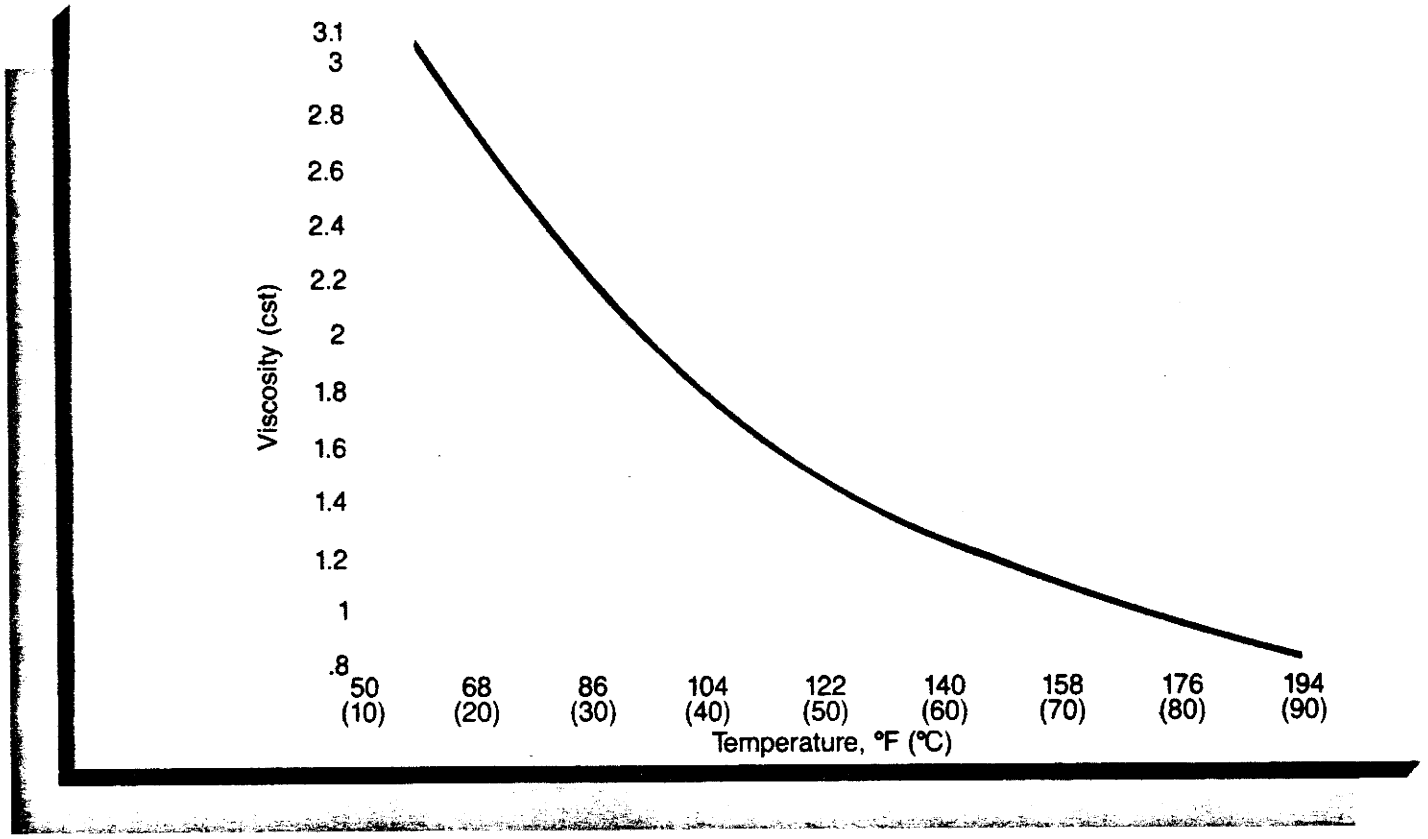
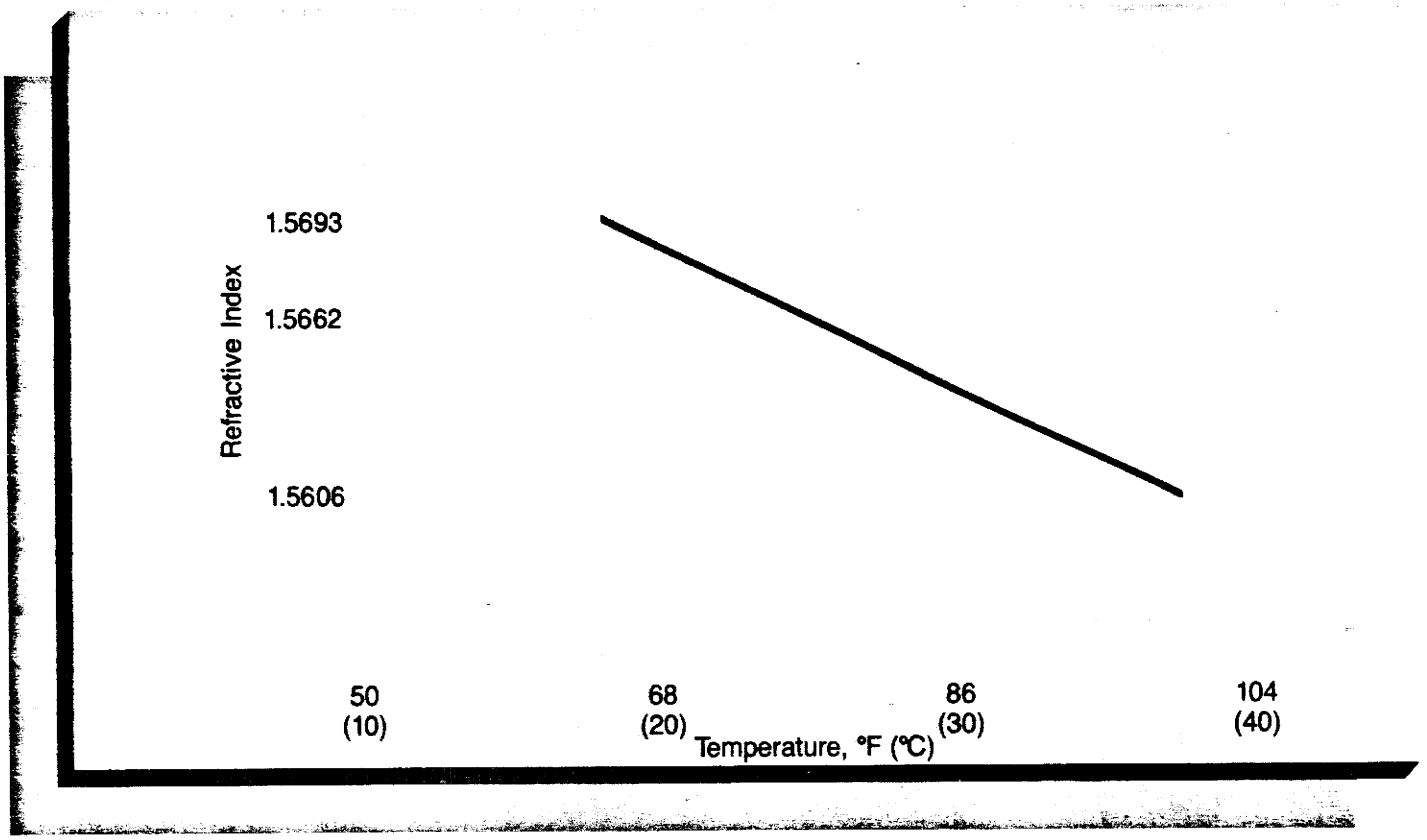


Figure 3 — Refractive Index vs. Temperature of VORANATE T-80 TDI



Handling Precautions

VORANATE T-80 Toluene Diisocyanates

To minimize the hazards associated with their use and to insure product quality, VORANATE T-80 Toluene Diisocyanates should be handled and stored only by knowledgeable and experienced personnel. Extreme care must be exercised to avoid exposing the products to water, heat, strong bases, and amines or other active hydrogen-containing compounds, all of which are among the most common sources of product contamination — a condition which can result in the explosive rupture of restricted lines and vessels due to the subsequent formation of carbon dioxide gas. Extreme care must also be exercised to minimize the hazards of fire and accidental spills — conditions which can release potentially harmful concentrations of isocyanate vapors. It is essential, therefore, before handling, using, or storing VORANATE T-80 Toluene Diisocyanates, that all personnel carefully read and understand each of the safety recommendations and precautions described in this booklet.

Moisture Control

The most common contaminant of isocyanates, and one of the more hazardous, is water, which, at room temperature, reacts readily with isocyanates to form both an insoluble urea compound and carbon dioxide. This insoluble urea derivative will be deposited on the surfaces of the equipment in which it is formed. Should lines and orifices become plugged, thus closing or restricting the vessel, liberated carbon dioxide could present an extreme pressure hazard. In short, the presence of water or large amounts of moisture can produce sufficient carbon dioxide to rupture the container. Even small quantities of water can cause significant problems. For example, at standard temperature and pressure, as little as 1 lb (0.454 kg) of water can release as much as 21 cu ft (0.6 cu meter) of CO_2.

Read and follow carefully each of the safety recommendations and precautions listed below:

- Do *not* tightly close vessels containing isocyanate if the product has been, or is suspected of having been, contaminated with water.
- To protect VORANATE T-80 Toluene Diisocyanates from atmospheric moisture, use a dry, −40°F (−40°C) dew point, inert gas pad. Dry air with the same dew point may also be used. However, nitrogen is preferred.
- Carefully clean equipment or containers to be used for isocyanates; then purge with a dry gas before using. The purge gas, in addition to being moisture-free, must also be free of oil and rust. Filter traps in the dry gas lines are recommended for the removal of rust particles.
- For small installations, manifold cylinders of dry nitrogen arranged into banks may be adequate. Larger installations, however, may call for a nitrogen generator, a compressed air system, or a tie-in to existing plant gas systems. If a plant air system is used, purification equipment, such as oil traps, a bauxite absorber to keep oil out of the drying beds, and an air dryer, should be installed between the compressor and the isocyanate system. Also, a final filter should be fitted just in front of the isocyanate system. Stainless steel pipe or tubing should be used between the filter and the system.
- Instrumentation for detecting the failure of the drying equipment for the purge gas is recommended when large quantities of isocyanate are handled and stored. Several moisture-detecting instruments are commercially available and may be readily obtained from manufacturers and suppliers listed on pages 33-36.
- When lines leading to and from storage tanks are not in use, they should be tightly plugged or capped. This will prevent moisture from coming in contact with residual isocyanate left in the lines. Also, all flexible connection lines should be rinsed with methylene chloride or another suitable solvent.[1] These fittings should be dried and stored in a dry place. A plastic bag containing a desiccant, such as silica gel, makes a convenient, portable dry place for storing such items.

[1]Most solvents possess hazardous properties and should be used with care. Also, be sure to read and follow all label directions and precautions.

Temperature Control

Ideally, VORANATE T-80 Toluene Diisocyanates should be stored at temperatures between 65°F (18°C) and 105°F (40°C). This may be accomplished by equipping the storage tank with either a heat exchanger installed in the storage tank recycle line or an external plate coil mounted on the outside of the tank. In addition, storage tanks should be insulated or otherwise protected from ambient weather conditions. Prolonged storage of VORANATE T-80 Toluene Diisocyanates at higher temperatures may cause the percent NCO (i.e., isocyanate) and viscosity to vary from product specifications.

Read and follow carefully each of the safety recommendations and precautions listed below:

- Before using VORANATE T-80 Toluene Diisocyanates that have been stored in tanks or drums for a lengthy period, warm, mix thoroughly, and inspect the products to be sure that no solids are present. **WARNING:** Do *not* breathe vapor. Vapor is extremely irritating if inhaled. See the "Toxicity" and "Health Hazards" sections under "Industrial Hygiene" on pages 17 and 18.

- If a storage tank is to be equipped with an external plate coil, be sure it is mounted on the exterior of the tank. This will not only eliminate the possibility of contamination of the isocyanate by a water leak in the heating coils, but will also minimize the possibility of localized overheating.

- If TDI should freeze — the freeze point is approximately 57°F (14°C) — the 2,4- and 2,6-isomers may separate. If this occurs, the TDI should be warmed to a maximum temperature of 95°F (35°C) and thoroughly mixed. Do *not* heat TDI above 105°F (40°C) as discoloration and dimerization may occur. Also, at temperatures above 212-248°F (100-120°C), TDI will trimerize in an exothermic reaction to form isocyanurates. This reaction may furnish enough heat (i.e., greater than 347°F [175°C]) to cause the formation of carbodiimides and the subsequent formation of carbon dioxide. This second reaction may create a pressure hazard in a closed or restricted vessel.

- During the winter, drum deliveries may arrive in a solid state. If this occurs, the TDI can be readily liquefied by heating the product to a maximum temperature of 95°F (35°C). Be sure that the liquefied TDI is thoroughly mixed before use. Also, do *not* use partially melted material. Since the 2,4-isomer melts at a higher temperature than the 2,6-isomer, the supernatant liquid in contact with the crystals will have a higher 2,6-isomer content than the completely liquid product. Also, since the 2,6-isomer reacts more slowly with compounds having an active hydrogen than does the 2,4-isomer, the supernatant liquid will have a slower reaction rate than the material as a whole. This could cause serious processing difficulties.

Contamination by Strong Bases

The presence of strong bases — even in small amounts — can cause any isocyanate to react with itself to form isocyanurates and carbodiimides. The carbodiimide formation is accompanied by the liberation of carbon dioxide, which may present a pressure hazard.

Read and follow carefully each of the safety recommendations and precautions listed below:

- Avoid any contact between isocyanates and strong bases, such as sodium and potassium hydroxide or alkoxides. Such compounds catalyze the rapid formation of isocyanurates and carbodiimides. Normally, the trimerization reaction occurs first, furnishing heat to cause the carbodiimide reaction. This second reaction liberates carbon dioxide and forms a hard solid or foam which can only be removed from the vessel or line by mechanical means. **WARNING:** The liberation of carbon dioxide in a tightly closed or restricted vessel may result in an explosive rupture.

- A likely source of contamination by strong bases is from industrial cleaning. Do *not* use, or permit the use of, sodium or potassium hydroxide or other strong bases in cleaning lines or vessels.

Contamination by Amines and Other Active Hydrogen-Containing Compounds

The primary dangers of contamination by amines and other active hydrogen-containing compounds are product contamination and the liberation of heat.

Read and follow carefully each of the safety recommendations and precautions listed below:

- Avoid contamination of VORANATE T-80 Toluene Diisocyanates by such compounds as alcohols, glycols, phenols, amines, amides, and acid anhydrides. Such compounds will react readily with isocyanates to form their corresponding addition products. Although reactions caused by contamination from amines or other active hydrogen-containing compounds do not release a gas, they do release considerable quantities of heat, which could ultimately lead to the homopolymerization of the isocyanate to carbodiimides, with a concurrent release of carbon dioxide. Contamination by heavy metal salts can also cause homopolymerization and should therefore be avoided. (See below.)

- In the event of gross contamination, the exothermic reaction could raise the temperature of the mixture above 212-248°F (100-120°C). This could result in the secondary reaction of trimerization — an exothermic reaction which, in turn, could raise the temperature of the mixture above 347°F (175°C). At this temperature, another secondary reaction — the homopolymerization of the isocyanate to carbodiimides — can occur, with a concurrent release of carbon dioxide. Finally, the release of quantities of carbon dioxide — especially in a closed or restricted vessel — could lead to an explosive rupture.

Fire Hazards

VORANATE T-80 Toluene Diisocyanates have been classified as Class III B combustible materials by the National Fire Protection Association. (Depending on the method used, the flash point of TDI is between 260 and 270°F [126-132°C]. The flammability limits in air are 0.9 to 9.5 percent.) In short, VORANATE T-80 Toluene Diisocyanates will burn in the presence of an existing fire or high heat source and adequate oxygen. The low volatility of isocyanates minimizes the potential hazard of explosion; however, under fire conditions in which a large concentration of isocyanate vapor is generated, explosive limits could be attained and an explosion could occur.

Read and follow carefully each of the safety recommendations and precautions listed below:

- In the event of an isocyanate fire, use a carbon dioxide or dry chemical extinguisher. For fires covering large areas, use a protein foam, Halon 1211 polymer, or water spray. When spraying water, be careful not to disperse any leaked or spilled isocyanate. Also, once the fire is out, any leaked or spilled isocyanate should be promptly contained and cleaned up. See "Spills and Leaks (Containment and Cleanup)."
- Personnel engaged in fighting isocyanate fires must be protected against nitrogen dioxide vapors as well as isocyanate fumes. Fire fighters should wear an approved[1] positive-pressure, self-contained breathing apparatus and fire-resistant clothing, footwear, and gloves.

Spills and Leaks (Containment and Cleanup)

Spills and leaks of VORANATE T-80 Toluene Diisocyanates should be contained by diking, if necessary, and cleaned up only by properly trained and equipped personnel. All others should promptly leave the contaminated area. Protective equipment should include appropriate respiratory protective devices (e.g., a positive-pressure, self-contained breathing apparatus) and impervious clothing, footwear, and gloves. In addition, all work areas should be equipped with safety showers and eye baths in good working order. Any isocyanate or other chemical accidentally spilled or leaked onto the skin should be quickly washed off. Also, an approved[1] respiratory protective device *must* be worn whenever there is any possibility of exposure to concentrations of vapors of TDI-based Specialty Isocyanates exceeding 0.02 ppm (0.14/mg/cu m). A positive-pressure, air-supplied, or self-contained breathing apparatus, equipped with a full facepiece, hood, or helmet, is recommended. See "Respirator Selection Guide" on page 17. (Note: Purchasers of VORANATE T-80 Toluene Diisocyanates automatically receive current Material Safety Data Sheets, which contain information about safe "spill and leak" handling procedures.)

[1]The authority for approving or certifying respiratory protective devices is held jointly by the National Institute for Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA). For current information on the status of approvals for respiratory protective devices, contact any of the manufacturers or suppliers listed on pages 39-41 or write to the National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, WV 26505 (phone: 304-291-4126).

Minor and Major Spills

In considering spills, it is useful to distinguish between minor incidents, such as may occur in a laboratory or workshop regularly handling isocyanates, and major spills, involving, for example, a railcar, storage tank, or bulk road tanker. The most important criterion for distinguishing between them is the ability of personnel on the scene to deal with the occurrence, rather than the actual scale of the incident. Hence, a minor spill is defined as one which can be dealt with using existing facilities, while a major spill is one that necessitates summoning outside assistance from, for example, the supplier, the police, fire services, or other emergency response personnel. It is important to remember, however, that even minor spills are potentially as hazardous as major spills, especially if they are not handled with care.

Drivers of tank trucks containing VORANATE T-80 Toluene Diisocyanates carry an "Emergency Response Information Sheet," which contains information on the safe handling of spills and leaks. In the event of a major spill, or for advice and/or assistance in containing and cleaning up spills and leaks of *any* size, call CHEMTREC (phone: 800-424-9300) or The Dow Chemical Company Distribution Emergency/Response Center in Freeport, TX (phone: 409-238-2112), or Midland, MI (phone: 517-636-4400). You may call these numbers at any time — day or night. See "Major Spills," page 11.

Minor Spills and Leaks

Method I: Using an Absorbent Material

All spills and leaks should be contained immediately to prevent further contamination of the surrounding area.

Read and follow carefully each of the safety recommendations and precautions listed below:

- Ventilate the contaminated area. Open all doors and windows. To avoid inhaling vapors of either the isocyanate or the decontaminants used, workers should wear appropriate respiratory protective devices; e.g., a positive-pressure, self-contained breathing apparatus. See "Respirator Selection Guide" on page 17.
- If the source of the leak is a damaged or leaking drum, it should be immediately moved outdoors or to an isolated, well-ventilated area and the contents carefully transferred to other suitable, leak-free containers. The damaged drum or container should be decontaminated as recommended on page 13. Also, the new container should be carefully checked to ensure that atmospheric moisture does not cause overpressurization. Leaking stationary containers should be temporarily patched, emptied, and thoroughly decontaminated. Permanent repairs can then be made.
- Completely cover the leak or spill with an absorbent material, such as sawdust, vermiculite, an all-purpose commercial oil absorbent, or sand. Use an amount greater than is estimated to be necessary to absorb the isocyanate.
- Carefully shovel the absorbent/isocyanate mixture into an open-top steel container; cover but do *not* make pressure tight. **Remove to a safe disposal site, away from the operating area, for neutralization.**
- Soak the mixture in the container with a solution of 5 percent ammonia in water and allow it to stand undisturbed for at least 48 hours. **WARNING:** Considerable heat, which could cause ignition, may be generated when the aqueous ammonia solution is first applied. After standing for 48 hours, however, the drum may be closed (though *not* pressure tight) and properly disposed of. See "Disposal" on page 13. To limit the amount of heat generated during the neutralization process, soak small quantities of the absorbent/isocyanate mixture in separate containers.
- Immediately after shoveling the absorbent/isocyanate mixture from the floor, complete the decontamination by mopping the floor using a water/ammonia solution with 1-2% added detergent. Be sure the area is well ventilated both during and after cleanup.
- Carefully test the atmosphere for residual isocyanate vapor. Instruments designed for TDI monitoring are available from several firms. See "VAPOR DETECTORS" in "Appendix A — Equipment Manufacturers and Suppliers: Bulk Handling and Storage Equipment," page 38.
- When safe working conditions have been reestablished, remove and decontaminate protective and return to normal operation.

Method II: Using a Premixed Isocyanate Neutralizer

The following is an effective alternative method for handling spills and leaks. All leaks and spills should be contained and immediately "neutralized" to prevent further contamination of the surrounding area.

Read and follow carefully each of the safety recommendations and precautions listed below:

- Always have a sufficient quantity of premixed isocyanate neutralizer, such as the one described, in storage. Premixed neutralizer may be stored in tightly closed heavy-duty polyethylene bags. Seal bags with wire twists. Also, the use of neutralizing solvents and other chemicals may introduce additional hazards of toxicity and flammability. Such materials, therefore, must be used in strict compliance with the manufacturer's recommendations and precautions.
- Ventilate the area. Open all doors and windows. To avoid inhalation of isocyanate vapors or the vapors of the decontaminants used, workers should wear appropriate respiratory protective devices (e.g., a positive-pressure, self-contained breath apparatus). See "Respirator Selection Guide" on page 17.
- If the source of the leak is a damaged or leaking drum, it should be immediately removed to the outdoors or to an isolated, well-ventilated area and the contents carefully transferred to other suitable, leak-free containers. The damaged drum or container should be decontaminated as recommended on page 13. Also, the new container should be carefully checked to ensure that atmospheric moisture does not cause overpressurization. Leaking stationary

containers should be temporarily patched, emptied, and thoroughly decontaminated. Permanent repairs can then be made.

- Promptly cover the spilled or leaked material with the neutralizer. For more effective coverage, and to ensure greater contact between the neutralizer and the isocyanate, use an industrial type heavy-duty broom to sweep the neutralizer into the spill.
- After the neutralizer has been on the spill for at least two hours, shovel the material into a steel container and dispose of properly. The broom should be wrapped carefully in plastic to contain the contaminants and then burned in an incinerator. See "Disposal" on page 13.
- Carefully test the atmosphere for residual isocyanate vapor. Instruments designed for TDI monitoring are available from a number of firms. See "VAPOR DETECTORS" in "Appendix A — Equipment Manufacturers and Suppliers' Bulk Handling and Storage Equipment." page 38
- When safe working conditions have been reestablished, remove and decontaminate protective equipment and return to normal operation.
- Note: The use of neutralizing solvents and other chemicals may introduce additional hazards of toxicity and flammability. Such materials, therefore, *must* be used in strict compliance with the manufacturer's recommendations and precautions.

This spill removal procedure is very effective in decontaminating an area. In situations where ventilation may be restricted, Method I was found to produce lower concentrations of isocyanate vapor during standardized tests.

ISOCYANATE NEUTRALIZER

Ingredients:

Sawdust	**22 lbs (10 kg)**
Fuller's Earth	**38 lbs (17.3 kg)**
Total Carrier Solids	**60 lbs (27.3 kg)**
Ethanol or Isopropyl Alcohol[1]	**19 lbs (8.6 kg)**
Triethanolamine[2]	**4 lbs (1.8 kg)**
Ammonium Hydroxide	**4 lbs (1.8 kg)**
Water	**12.8 lbs (5.8 kg)**
Dye	**0.2 lbs (0.1 kg)**
Total Active Solution	**40 lbs (18.1 kg)**
Total Neutralizer Mixture	**100 lbs (45.4 kg)**

Directions:

1. Mix the water, dye and solids.
2. Add the remaining ingredients and stir.
3. Store in neutralizer in polyethylene bags.

[1]CAUTION: Alcohols are highly flammable. Keep neutralizer mixture away from heat or open flame. Propylene glycol (flash point at 210°F [99°C]) can be substituted for isopropyl alcohol to reduce the flammability problem that occurs with alcohol.

[2]Conventional urethane amine catalysts may be substituted for triethanolamine.

Major Spills

In the event of a major spill, a *State of Emergency* should be assumed to exist in the affected area. The declaration of a *State of Emergency* usually requires the involvement and close cooperation of various local emergency response services, such as police and fire units, etc. Thus, contingency arrangements and safe handling and decontamination procedures should be discussed in detail beforehand with emergency response personnel.

Read and follow carefully each of the safety recommendations and precautions listed below:

- *Note:* In the event of a *major* spill (such as overturned tank trucks or tank cars, ruptured storage tanks, etc.), or a spill of *any* size about which there is doubt or uncertainty, alert local emergency response service units, then call CHEMTREC (see box) or The Dow Chemical Company Distribution Emergency/Response Center immediately in Freeport, TX (phone: 409-238-2112), or Midland, MI (phone: 517-636-4400). You may call these numbers at any time — day or night.

CHEMTREC

FOR CHEMICAL EMERGENCY
Spill, Leak, Fire, Exposure, or Accident
CALL CHEMTREC
DAY OR NIGHT
***800-424-9300**
Toll-free in the continental U.S.
*Add long-distance access number if required

483-7616 in District of Columbia

For calls originating outside the Continental U.S.: 202-483-7616
— Washington, DC, Collect
ALL CALLS ARE RECORDED

CMA

- All persons not properly equipped with protective clothing and appropriate respiratory devices should immediately leave the site of the spill and should remain upwind.
- Only experienced and properly equipped personnel should be authorized to attempt to isolate or contain the spill. Do *not* wash spilled isocyanates down a drain or into a river, creek, or other body of water.
- Keep all improperly equipped and unauthorized personnel away from the area of the spill.
- To contain the spill temporarily, to minimize vapor contamination of the air, and to "buy time" until the spill can be properly "diked" and the necessary decontamination materials assembled, cover the isocyanate with a coating of 3% protein (fire-fighting) foam. Most fire-fighting services have protein foams or similar foam systems. Also, the foam may have to be reapplied to the spill every 30 minutes until effective neutralizing materials can be obtained.

  Note: Although, under certain circumstances, water is an acceptable decontaminant for isocyanates, mixing water and isocyanates in confined areas — even in small amounts — is hazardous. Protein and other water-based foam systems, therefore, should be used only in open areas. Also, be sure the equipment is producing a good quality foam before applying the mixture to the spill.
- *CAUTION:* Decontamination and clean-up of major spills can be a complex and hazardous operation, and all the details and operating procedures are not outlined above. A more extensive discussion of the subject, however, can be found in the International Isocyanate Institute Technical Bulletin No. 1, *Recommendations for the Handling of Toluene Diisocyanate (TDI).* For a copy, write to the International Isocyanate Institute, Inc., 119 Cherry Hill Road, Parsippany, NJ 07054.

Cold Weather Spills

During cold weather, spilled or leaked VORANATE T-80 Toluene Diisocyanates may freeze. Under these conditions, the use of ammonia and water will merely coat the material with an insoluble urea, stopping further reaction. It is essential, therefore, to use a solution that will not only dissolve the isocyanate, but will also form a liquid product during decontamination.

Read and follow carefully each of the safety recommendations and precautions listed below:

- Ventilate the contaminated area. Open all doors and windows. To avoid inhalation of the vapors of either the isocyanate or the decontaminants used, workers should wear appropriate respiratory protective devices (e.g., a positive-pressure, self-contained breathing apparatus). See "Respirator Selection Guide," page 17.
- If any of the leaked or spilled isocyanate is still in liquid or absorbable form, cover it immediately with an absorbent material, such as sawdust, vermiculite, an all-purpose commercial oil absorbent, or sand. Use an amount greater than is estimated to be necessary to absorb the isocyanate.
- Carefully shovel the absorbent/isocyanate mixture into an open-top steel drum; cover, but do *not* make pressure tight. Remove to a safe site, away from the operating area, for neutralization.
- For that part of the spill or leak which is no longer liquid or absorbable, estimate the quantity spilled, and make up a mixture of approximately 50% isopropyl alcohol[1] and 50% 1,1,1-trichloroethane by volume, using the same volume of each solvent as the estimated volume of spilled isocyanate.
- Completely cover the spilled material with the alcohol/1,1,1-trichloroethane solution. Allow the solution to remain in place for at least one hour.

[1]CAUTION: Alcohols are highly flammable. Keep neutralizer mixture away from heat or open flame.

- Cover the area with enough absorbent material to soak up all the liquid. Shovel this material into open-top steel containers, treat, and dispose of properly. Finally, if the temperature is above freezing, carefully wash down the contaminated area with copious amounts of water. (Special efforts should be made to prevent the spilled material from entering waterways or drains. If spilled material does enter waterways or drains, notify local authorities at once.) Also, thoroughly air or ventilate the decontaminated area to remove all traces of vapor.
- Note: The use of decontaminating solvents and other chemicals may introduce additional hazards of toxicity and flammability. Thus, such materials must be used with care and in strict compliance with the manufacturer's recommendations and precautions.

Pressurized Drums

Any drums seen to be in a pressurized state (i.e., misshapen due to the presence of carbon dioxide gas) should be covered immediately (e.g., with heavy tarpaulins), isolated, and watched carefully. These operations should be carried out only by competent and experienced personnel, wearing full emergency protective equipment. If, after careful inspection by a competent person, the drum is judged not to be in an explosive or immediately dangerous state, the pressure should be relieved either by carefully loosening the bung or, in severe cases, by puncturing with a long-handled device.

If the pressure is successfully relieved by simply loosening the bung, the product, if not contaminated or otherwise unusable, should be used immediately. If, however, the product is unusuable, re-cover the drum with the tarpaulin and watch for signs

of further reaction. Then, when it is deemed safe, carefully dispose of both the product and drum. See "Disposal," page 13. If puncturing action is to be taken, be sure that all necessary materials and equipment for cleanup and decontamination are readily available. See the following sections on "Drum Decontamination" and "Disposal." Also, in cases of doubt or uncertainty, call The Dow Chemical Company Emergency/ Response Center in Freeport, TX (phone: 409-238-2112).

Drum Decontamination

Read and follow carefully each of the safety recommendations and precautions listed below:

Isocyanates remaining after the emptying of drums may be decontaminated by the following procedures:

- Remove emptied drums from the work area to a well-ventilated location or to the out-of-doors.
- Remove all bungs and fill drums with water. Wear protective equipment and keep face away from bungholes while filling. Also, *DO NOT REINSTALL BUNGS.*
- Allow drums to stand undisturbed for 24 hours or until the residual TDI has been completely converted to solid urea. (Note: A dilute solution of aqueous ammonia or isopropyl alcohol may be added to the water to speed up the reaction.) Please refer to disposal method on the Material Safety Data Sheet and label.
- All drums should be scrapped. They should be drained and holed or crushed to render them totally unusable. Please refer to disposal method on the Material Safety Data Sheet and label.
- Dispose of drums and rinse fluid according to federal, state, and local regulations.

Disposal

Read and follow carefully each of the safety recommendations and precautions listed below:

- Only thoroughly trained and properly equipped persons should be permitted to participate in disposal operations.
- Keep waste isocyanate and waste polyols widely separated.
- Be certain that all disposal procedures are conducted in strict compliance with all applicable federal, state, and local regulations and ordinances. Isocyanate is listed as a hazardous waste (U223) and falls under Section 3001 of the Resource Conservation and Recovery Act (RCRA). Users of isocyanates should be aware of and follow the disposal provisions of that act, as well as other state and local environmental control regulations.

Other Polyurethane Chemicals

Each of these chemicals has its own profile of hazards and recommended safety precautions. It is essential, therefore, that users contact their suppliers for specific instruction on the safe handling, use, storage, and disposal of each of these products.

Polyols

Most polyols are very low in acute oral toxicity and are considered only mildly irritating to eyes and skin. However, despite their relatively innocuous characteristics (compared with those of the various isocyanates), they should be handled with appropriate caution and in strict accordance with the manufacturer's recommendations. *Skin and eye contact should be avoided.* Eye protection, such as safety glasses or their equivalent, should be worn whenever polyols are handled or used. Also, because polyols are frequently used with chemicals that present an inhalation hazard, appropriate caution dictates thorough ventilation of all storage, handling, and manufacturing facilities.

Flash points for most polyols — including polyesters and polyethers — range from approximately 300° to 500°F (149° to 260°C). They can, therefore, be categorized as Class IIB combustible liquids, and, as such, do not present an unreasonable fire risk. However, it should be noted that, if exposed to sufficient heat and oxygen, *they will burn.* Fires involving polyols can be readily extinguished with water spray, foam, carbon dioxide, or dry chemical extinguishers. Furthermore, polyols, like most organic substances, could, if heated to decomposition in a confined location, generate sufficient volatile decomposition products to present an explosion risk. See supplier's literature.

Catalysts

Catalysts are used in polyurethane chemistry to control both the polymer and gas-formation reactions. They are generally metal salts (e.g., stannous octoate) or tertiary amines (e.g., triethylenediamine). Both types of catalysts can be toxic, can burn intact skin, and can induce sensitization. Eye contact can cause severe irritation, or possibly a burn. *With either type of catalyst, therefore, skin and eye contact must be avoided.* Follow the manufacturer's recommendations for safe handling.

Many liquid amine catalysts have Tag Open Cup flash points in the range of 20° to 115°F (−6° to 46°C) and are classified, depending upon the flash point, as flammable or combustible liquids. Because of their volatility and flammability, therefore, tertiary amines should be considered fire hazards.

Users are cautioned to secure specific handling and disposal information from their catalyst suppliers.

Blowing Agents

Halocarbon blowing agents are commonly used in polyurethane foam manufacture and represent a significant health hazard.

Commonly used halocarbons are listed below.

Although fluorocarbon blowing agents are generally considered nonflammable, they can, when heated to decomposition (as when drawn through a lit cigarette), generate quantities of highly toxic carbonyl chloride (phosgene) and carbonyl fluoride. Thus, smoking, open flames, or use of electrical equipment which might arc should be strictly prohibited. In addition, when confined and subjected to high temperatures, fluorocarbon blowing agents may also present a serious pressure hazard.

Like the fluorocarbons, methylene chloride has neither a flash point nor a fire point as reported by any of the standard test methods: Tag Open Cup, Tag Closed Cup, Cleveland Open Cup. However, the National Fire Protection Association reports flammable limits in pure oxygen between 15.5% and 66% by volume of $MeCl_2$, and Dow laboratory data indicate flammable limits in air of 13-23% by volume at 77°F (25°C). However, when heated to decomposition, it too will produce a variety of hazardous and toxic materials, such as hydrochloric acid, chlorine, carbon dioxide, and carbon monoxide.

Methylene chloride has been shown to increase the rate of spontaneously occurring tumors in certain laboratory animals following lifetime inhalation exposures. However, methylene chloride is not believed to pose a measurable carcinogenic risk to man when handled as recommended.

The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for methylene chloride is currently 500 ppm, with an acceptable ceiling limit concentration at 1,000 ppm. The acceptable maximum peak above the acceptable ceiling concentration for any 8-hour shift is 2,000 ppm (as 5 minutes in any 2 hours). The TLV adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) is 100 ppm (TWA). (This TWA value is on the 1987-88 intended change list, with a suggested value of 50 ppm.)

Users are urged to contact their suppliers for detailed information and instructions on the handling and disposal of these blowing agents.

Miscellaneous Products

Many other additives, such as surfactants, fillers, fire retardants, pigments, and dyes, are used in various polyurethane applications. Each has its own profile of hazards and recommended safety precautions. It is essential, therefore, that users contact their suppliers for specific instructions on the safe handling, use, storage, and disposal of each of these products.

Trichlorofluoromethane (R-11)	**75°F (23°C) boiling point**
Dichloromethane (methylene chloride)	**104°F (40°C) boiling point**
Trichlorotrifluoroethane (R-113)	**114°F (45°C) boiling point**

CAUTION: Inhalation of high concentrations of the vapors of these products can be dangerous and may cause anesthesia and unconsciousness. Cases have also been cited showing that severe acute exposures to some fluorocarbons have caused cardiac arrythmias, including ventricular fibrillation. Also, since halocarbon vapors are heavier than air (i.e., have a higher vapor density), they can, at high concentrations, accumulate in confined or low-lying areas, where they can displace the air or oxygen supply. Thus, adequate ventilation in all work areas is essential.

Application Hazards of Polyurethane Foams

Polyurethane chemicals and foams, like many other industrial materials, can be hazardous if misused or improperly handled. However, when potential hazards are recognized and procedures for safe handling and storage are understood and practiced, polyurethane chemicals can be used safely.

Dust

Dust produced during the cutting and sawing of rigid polyurethane foam can cause irritation of the eyes, nose, and throat. In addition, laboratory studies with rats indicate that long-term respiratory difficulties may be caused by exposure to large quantities of finely ground polyurethane dust. It is imperative, therefore, that the generation and accumulation of dusts be carefully controlled during fabrication. If it is not feasible to install control devices, such as ventilators, then suitable equipment for respiratory and eye protection (such as dust masks, etc.) should be worn by all persons who may be exposed to such dusts.

In addition, finely divided airborne polyurethane dust can, under the proper conditions, produce a "dust explosion." Even settled dust can be made potentially explosive by relatively low order concussions which can raise the dust into airborne "clouds." To ensure safe working conditions, therefore, it is essential that workers exercise extreme care and practice good housekeeping in all polyurethane foam fabrication areas.

Note: VORANATE T-80 Toluene Diisocyanates are normally used in the manufacture of flexible and semi-flexible foams, which are cut by a slicing or scissoring action — procedures which are not likely to produce dust. In contrast, VORANATE Specialty Diisocyanates are generally used to produce rigid foams — materials which are usually cut by "sawing," a process which frequently produces a dust-like by-product.

Combustibility

While product composition may vary, virtually all polyurethane foams will burn, often generating a variety of toxic gases and dense clouds of black smoke. *Even when fire retardant chemicals have been added to the formulation, the end product — under the right conditions of heat and oxygen supply — will burn.* It is essential, therefore, that urethane foam producers, fabricators, and end users know and understand the combustibility hazards and burning characteristics of the final foam product.

Products of Combustion

When polyurethane burns, many products of combustion are released. What and how much are released varies with product composition, fire conditions, oxygen level, and other factors. As in all organic fires, however, large quantities of carbon monoxide, as well as other products can be anticipated. In addition, large quantities of dense, dark smoke will be quickly generated, which may make it difficult to escape from the fire area.

Burning Characteristics

While many different tests are used to define the burning characteristics of polyurethane foam — some are small-scale tests useful only in comparing different products — none is comprehensive enough to define the hazards in all potential fire situations. In short, no two fires are the same. Fire conditions vary with room size, ventilation, available oxygen, fuel load, ignition sources, types of materials present, and other factors. Also, how a given polyurethane material will react to such varying conditions depends on the type of foam, the type of covering or flame barrier, the character and source of ignition, the proximity to ignition or heat, etc. It is unlikely, therefore, that all potential hazards can be defined for a fire condition. However, when used and stored with known limitations, polyurethane foams can be handled with minimal hazard.

Slabstock Foam Fires

The producer of polyurethane foam slab stock must be aware of *both* the exothermic (heat generating) nature of the polyurethane foam reaction and of the insulating properties of the foam produced. On occasion, extremely reactive systems and those which have been improperly formulated (i.e., "off-ratio" due to mechanical failure or errors in calculation) can develop "time-temperature" conditions in the bun center, which can result in autoignition. This can occur several hours after bun manufacture, when the material is largely unattended. It is important, therefore, that the heat generated in the center of a bun be safely dissipated through correct storage procedures.

Although the potential for fire exists, serious risk situations can usually be recognized during, or right after, foam manufacture, when protective action can be taken. Also, similar conditions may exist in other polyurethane applications, particularly in spraying operations, where large masses of polyurethane polymer may be formed. Safety precautions similar to those for slabstock should be carefully followed.

Read and follow carefully each of the safety recommendations and precautions listed below:

- Allow buns to cure and cool completely before stacking or storing. High air flow along the sides of fresh or hot buns may draw off reaction products and cause an influx of oxygen. This can cause rapid depletion of the antioxidant and could result in autoignition.
- Monitor bun temperatures at the center of the mass on a routine basis. This is particularly important with new formulations or new bun sizes.
- Design and construct slabstock pouring equipment to ensure "on-ratio" metering. Be sure equipment is kept carefully calibrated and in good working order.
- Cure bunstock in isolated areas equipped with effective fire detection equipment and sprinkler systems. Raw foam and fabricated items should be stored indoors, away from fabricating operations, and should be protected by automatic sprinklers. Also, access aisles should be maintained between columns of stacked buns. See Factory Mutual System bulletin *Storage of Flexible Polyurethane* (8-178) for recommendations on stacking foam and installing sprinkler systems.
- Do *not* smoke in storage areas. Large quantities of stored polyurethane foams or products can be a tremendous fuel source in the event of a small fire. In laying out manufacturing and storage areas, therefore, designers should consider maximum storage area, possible source of ignition, and the location and effectiveness of fire and smoke detection equipment and sprinkler systems.

Construction Foam Fires

Polyurethane foam used for insulation can be a combustion hazard if left exposed or unprotected. For example, fire statistics show that most fires involving rigid polyurethane foam insulation have occurred in buildings under construction, where foam was left exposed or unprotected by an approved thermal barrier and was ignited by welding, cutting, or burning operations. Since VORANATE T-80 Toluene Diisocyanates are not normally used to make the type of rigid foam used in construction applications, see Dow bulletin *Safe Handling and Storage of VORANATE Specialty Isocyanates* (Form No. 109-546-82) for a full discussion of construction foam fires. Copies are available upon request from any Dow sales office or The Dow Chemical Company, Plastics Group, 2040 Willard H. Dow Center, Midland, MI 48674.

Cushion Foam Fires

Many of the fire deaths in the U.S. are attributed to the misuse of smoking materials. Such fires frequently start in upholstered furniture and bedding. As a consequence, various regulations have been passed or proposed requiring mattresses and other upholstered furniture to meet specified combustibility tests. Although these regulations vary, depending upon the intended use of the item to be tested, a proper combination of foam and covering material can now be selected to meet the standards established by these tests. It is essential, therefore, that manufacturers of polyurethane foam and foam products keep themselves fully informed of both the combustibility hazards associated with the use of polyurethane foams and of the changing regulations at the federal, state, and local levels.

For additional information on the fire hazard associated with flexible polyurethane foam, see the following bulletins: *Using Flexible Polyurethane Foam Safely* (U106) and *Fire Safety Guidelines on Flexible Polyurethane Foams Used in Upholstered Furniture and Bedding* (U111). Copies are available from The Society of the Plastics Industry, 355 Lexington Avenue, New York, NY 10017. Another bulletin, *The Toxicity for the Airborne Combustion Products of Polyurethane Foams*, which reviews current data on fire gas toxicity in polyurethane foam fires, is available from the International Isocyanate Institute, Inc. 119 Cherry Hill Road, Parsippany, NJ 07054.

Extinguishing Fires

Read and follow carefully each of the safety recommendations and precautions listed below:

- Know where all fire extinguishers are located and how to use them.
- For small polyurethane foam fires, use water, foam, dry chemicals, or carbon dioxide. Large fires of burning foam, however, should be drenched with large quantities of water from sprinklers or fire hoses.
- Because polyurethane foam is a good insulator, it is necessary to disperse and carefully inspect the foam after drenching to be certain that the fire has been completely extinguished.
- Hazards of rapid heat buildup, rapid flashover, and oxygen depletion exist when fighting fires in enclosed areas. Thus, fire fighters should be equipped with approved, positive-pressure, self-contained breathing apparatus and protective clothing when extinguishing polyurethane fires of *any* magnitude.

Fire Safety and Prevention

Read and follow carefully each of the safety recommendations and precautions listed below:

- All workers should be thoroughly familiar with the plant's fire emergency procedures.
- Workers should know where all exits are located. Also, access to exits should be kept clear and unobstructed.
- Smoking in areas where foams are made or stored should be strictly prohibited. No smoking areas should be clearly posted with large "NO SMOKING" signs.
- Welding torches, open flames, or other sources of high heat or ignition should be prohibited in areas where foams are made or stored.
- Keep work areas clean. Promptly and properly dispose of foam scraps, dust, and other waste materials.

Handling Precautions Summary

To minimize the hazards associated with the handling, use, and storage of polyurethane chemicals and polymers . . .

Read and follow carefully each of the safety recommendations and precautions listed below:

- Never work alone when using or handling reactive chemicals.
- Do *not* inhale vapors or mists. Be sure work areas are adequately ventilated to control vapors below employee exposure limits established by the Occupational Safety and Health Administration (OSHA)[1] and, when needed, have workers wear approved respiratory protective devices, particularly when handling isocyanates, amines, or solvated adhesives. See "Respirator Selection Guide" on page 17.
- Avoid skin and eye contact with all formulation chemicals. Be sure all workers are properly equipped with protective clothing and eye protection.
- Candidates for employment where occupational exposure to isocyanates may occur should be examined for deficits in pulmonary function with particular emphasis on allergic history including asthma or other diseases that compromise pulmonary function. Employment in an isocyanate area may present a health risk to individuals with such abnormalities.
- Handle freshly polymerized parts with care. Be aware of the potential hazards of toxic vapors and of the heat of cure.
- Do *not* stack fresh polyurethane buns. Insulation of the heat can cause spontaneous combustion.
- Equip polyurethane foam storage areas with sprinkler systems.
- Keep adequate quantities of isocyanate neutralizer on hand for quick decontamination of work areas in the event of spills or leaks.
- Never expose isocyanate in containers to water, amines, or other reactive chemicals.
- Never expose polyurethane chemicals in closed containers to elevated temperatures.
- Never expose a polyurethane foam to an open flame or other high heat source.
- Always use proper dust handling equipment and dust filter masks when sawing or fabricating polyurethane foams or parts.

[1]See "OSHA Safety and Health Standards (29 CFR 1910)." Copies are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Hazard and Exposure Guidelines

The potential hazard of a given material is based on the degree of toxicity, the individual susceptibility of the user, and on the likelihood and level of exposure. Responsible users of chemical and industrial materials, therefore, must be concerned not only with the inherent acute and chronic toxicity of such materials, but also with the potential for exposure which may be encountered under specific use conditions. In general, the greater the toxicity, the greater must be the control over the level of exposure.

While there are potential hazards associated with such materials as catalysts and blowing agents, the primary hazard in polyurethane chemical applications is associated with the TDI component, and particularly with the inhalation of its vapors. As such, limits have been established regarding allowable TDI vapor concentrations in the work environment.

In the United States, vapor levels of TDI are to be controlled according to standards established by the Occupational Health and Safety Administration (OSHA). The OSHA Permissible Exposure Limit (PEL) for TDI is 0.02 ppm as a ceiling limit. The Dow Chemical Company has also set 0.02 ppm ceiling as its Industrial Hygiene Guide (IHG). Ceiling limit is defined as the maximum concentration which should not be exceeded during the exposure. Recent information presented at the International Isocyanate Institute's Symposium on Diisocyanates (Pittsburgh, 1987) indicates that allergic sensitization results from even brief exposure to high concentrations of TDI. Exposures to low concentrations below the OSHA PEL of 0.02 ppm are not likely to result in allergic sensitization. This information stresses the importance of controlling vapor levels below the ceiling limit. Current paper tape monitoring methodologies measure concentrations of TDI with sampling periods ranging from 0.5 to 9 minutes. However, it is an acceptable industrial hygiene practice to assess exposures to materials with ceiling limits using sample times of up to 15 minutes if instantaneous (real time) monitoring is not feasible.

Other advisory groups have also set more conservative guidelines. In 1983, the American Conference of Governmental Industrial Hygienists (ACGIH) adopted a Threshold Limit Value (TLV) for TDI of 0.005 ppm as an 8-hour time-weighted average (TWA) with 0.02 ppm as the Short-Term Exposure Limit (STEL). The TWA is the concentration to which it is believed nearly all workers may be repeatedly exposed for 8 hours a day, 40 hours a week, without adverse effect. ACGIH defines a STEL as a 15-minute TWA exposure which should not be exceeded at any time during a work day even if the 8-hour TWA is within the TLV. Other restraints of a STEL are (a) the STEL should not be longer than 15 minutes, (b) the STEL should not be repeated more than four times per day and (c) there should be at least 60 minutes between successive exposures at the STEL.

Although the National Institute for Occupational Safety and Health (NIOSH) has published two criteria documents applicable to occupational exposures to TDI, OSHA had taken no formal action on NIOSH's recommendations. The first criteria document (1973) recommended that exposure to TDI be controlled to 0.005 ppm as an 8-hour TWA or to 0.02 ppm for any 20-minute period. The second criteria document (1978) recommended that exposures to certain diisocyanates (including TDI) be controlled to a TWA limit of 0.005 ppm for a 10-hour workshift, 40-hour workweek, and a ceiling limit of 0.02 ppm for a 10-minute sampling period. Their rationale was that this type of control would afford employees protection from respiratory effects including direct irritation, sensitization, and chronic decrease in pulmonary function.

Table 3 — Respirator Selection Guide for Protection Against Diisocyanate Vapors[1]

Concentration	Respirator Type (Approved Under Provision of 30 CFR 11[2])
Less than or equal to 1,000 ppb	Type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode or with full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 1,000 ppb	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode. (2) Combination respirator including Type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure model with auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Firefighting and Emergency	Self-contained breathing apparatus with full facepiece, operated in pressure-demand or other positive pressure mode.

[1]Source: DHEW (NIOSH) Publication #78-215

[2]Use of supplied-air suits may be necessary to prevent skin contact during exposure at high concentrations of airborne diisocyanates.

Further information can be obtained by requesting the NIOSH Criteria Document for Diisocyanates (DEHW Publication No. 78-215) from the National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, WV 26505.

It is important to remember that while these values represent current thinking and are believed to be conservative, they offer no guarantee of absolute safety. It is imperative that personnel working with TDI understand fully the hazards associated with its use and are familiar with those procedures which have been designed to minimize the hazards involved. Exposure guidelines are reviewed regularly and changed when new information dictates a need. Users of these chemicals need to keep fully informed on the most current guidelines and regulations.

Read and follow carefully each of the safety recommendations and precautions listed below:

- All employees must be instructed and periodically retrained in the use of all protective and emergency equipment, as well as in preventive procedures. Important to any safety program is thorough worker education. In short, the best planned procedures do no good if they are not understood and followed. Similarly, the best safety equipment is useless if it is not properly used and maintained. The use of personal protective equipment must comply with OSHA regulations 29, Code of Federal Regulations (CFR) 1910.132 to 1910.140.
- Proper respiratory protective equipment should be readily available and in good working order. For nonroutine operations, or where vapor levels cannot be controlled by ventilation alone, all personnel should use appropriate respiratory protective devices. Also, only those devices approved by the National Institute for Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA) should be used.
- Regularly inspect and repair exhaust and other ventilating equipment. Also, work area atmospheres should be tested periodically by trained industrial hygienists to be sure that airborne TDI vapors are being controlled to acceptable levels. TDI and other toxic vapor levels in the work environment are best controlled by properly designed and maintained process and exhaust equipment. Combined with safe work procedures, properly designed equipment in good working order can maintain vapor levels within acceptable limits. **WARNING:** Tests have shown that the least detectable odor level of TDI is approximately 0.2-0.4 ppm. Because this odor threshold occurs at levels significantly higher than allowable exposure concentrations, vapor levels *must* be monitored using equipment specifically designed for that purpose. Instruments designed for TDI personal and area monitoring are available from GMD Systems Inc., MDA Scientific, Inc., and National Draeger, Inc. (see Appendix A for addresses). For additional information, contact The Dow Chemical Company, Industrial Hygiene Office (phone: 517-636-0860).
- Prevent contact with TDI and other polyurethane chemicals. Skin and eye contact with TDI and other polyurethane chemicals may result in injury and, in some cases, in sensitization. It is essential, therefore, that operating and ventilating equipment be properly designed and maintained, and that all procedures for the safe handling, use, and storage of polyurethane chemicals be fully understood and followed. Also, protective clothing, gloves, boots, and chemical goggles or face shields *must* be worn whenever isocyanates are handled, stored, or used, or whenever there is *any* possibility of exposure.
- Eyewash fountains and safety showers should be installed and kept in working condition in areas where contact with TDI can occur. It is important that the number and location of such units be designed to serve both individual and multiple-employee exposures.
- Employees should have medical surveillance, designed to detect any evidence of adverse effects due to exposure to TDI.

Health Hazards

Inhalation

Toluene diisocyanate vapors are irritating to the mucous membranes of the upper and lower respiratory tracts. Even very brief exposures to these vapors may cause irritation and difficult or labored breathing, including a "burning" throat, deep coughing, and choking, as well as nausea, vomiting, and abdominal pain. Also, inhalation of isocyanate vapors may cause changes in lung function or chronic lung effects. Furthermore, exposure to isocyanate vapors may cause sensitization or hypersensitivity which on subsequent exposure, even to concentrations below 0.02 ppm, may result in severe allergic respiratory reactions.

CAUTION: Inhalation of vapors of heated isocyanates can be extremely hazardous, not only because high vapor concentrations are formed, but also because condensation may form airborne droplets. An approved respiratory protective device *must* be worn, therefore, whenever there is *any* possibility of exposure to unknown concentrations of vapors. See "Appendix B," page 39, for a list of manufacturers and suppliers of approved respiratory protective equipment.

Skin Contact

Repeated or prolonged contact with TDI may cause redness, swelling, blistering, and burns. Also, direct contact may produce sensitization (contact dermatitis as well as respiratory sensitization). Therefore, any contact with the spray, vapor, or liquid must be prevented. Protective clothing, including rubber or plastic aprons, rubber gloves and footwear, chemical goggles or faceshields, etc., should be worn whenever there is *any* possibility of direct contact with isocyanates. Also, safety showers should be installed, and kept in working condition, in and near all work areas where TDI is used.

Eye Contact

While brief eye contact with low concentrations of TDI vapor may cause only mild tearing or a slight burning sensation, contact with high concentrations of vapors or mists may cause severe pain and irritation. Furthermore, direct contact with TDI liquid may be extremely painful and may cause both severe irritation and permanent injury. *Chemical workers' goggles should be worn whenever TDI is handled, stored, or used, or whenever there is any possibility of direct contact with TDI liquid or mist.* In the event of contact, immediate decontamination with water will assist in preventing injury. Thus, eye baths should be installed, and kept in working condition, in *all* work areas where TDI is used.

Ingestion

Although VORANATE T-80 Toluene Diisocyanates have a low level of acute oral toxicity (e.g., LD_{50} rats >4g/kg), they can irritate or burn the mucous membranes of the mouth, esophagus, and stomach. While accidental ingestion in an industrial environment is highly improbable, it *is* possible. Therefore, foodstuffs should not be prepared or consumed where TDI is used, handled, or stored. Also, in the event of accidental ingestion, workers should be prepared to administer emergency first aid.

A current Material Safety Data Sheet (MSDS) must be obtained and reviewed before any TDI product is used. Copies are available to customers from our toll-free number: 1-800-238-CHEM. Copies are also available from any Dow sales office or The Dow Chemical Company, Plastics Group, 2040 Willard H. Dow Center, Midland, MI 48674. Current MSDSs must also be obtained from suppliers of other products prior to handling or formulating.

Chronic Toxicity

Recently, both the National Toxicology Program (NTP) and the International Agency for Research on Cancer (IARC) designated TDI as a potential carcinogen. Both agencies based their conclusions primarily on the results of a recent NTP study which reports increased numbers of tumors in rats and mice dosed orally with TDI. The agencies accept this as a valid animal study; however, a number of deficiencies have been cited which may compromise its validity. In addition, results of a chronic inhalation study contradict the findings of the NTP study, and are deemed more relevant to the exposures experienced in occupational settings. This inhalation study, contracted by the International Isocyanate Institute, reports no increase in tumors in rats and mice exposed to TDI for their lifetime.

At this time it is not believed that TDI represents a significant cancer hazard when atmospheric levels are maintained below the recommended exposure guidelines. Based on currently available data from lifetime inhalation studies in rats and mice, Dow recommends the OSHA standard of 0.02 ppm as a ceiling limit for TDI.

First Aid

All employees working in areas where contact with isocyanate is possible should be thoroughly trained in the administration of appropriate emergency first aid. Experience has demonstrated that prompt administration of such aid can be important in minimizing the possible adverse effects of accidental exposure. CAUTION: First aid is "emergency treatment" only, and medical attention from a qualified physician should be provided as soon as possible.

Inhalation

Promptly move the affected person away from the contaminated area and to fresh air. Quickly remove all contaminated clothing. Keep the affected person calm and warm, but not hot. If breathing stops, administer mouth-to-mouth resuscitation. Immediately transport to a medical facility and inform medical personnel about the nature and extent of the exposure. Never attempt to give anything by mouth to an unconscious person.

Skin Contact

In the event of direct contact with the skin, immediately get under a safety shower. Immediately remove all clothing and shoes while under the shower. Thoroughly wash the affected skin, using copious amounts of water. If necessary (i.e., in the event of burned or damaged skin, or if redness or irritation persists), seek medical attention. Contaminated clothing should *not* be worn again until laundered. Shoes, belts, watchbands, and other leather items should be destroyed.

Eye Contact

If VORANATE T-80 Toluene Diisocyanates contact the eyes, decontaminate immediately. Irrigate the eyes immediately and continuously with water *for at least 15 minutes. Seek medical attention at once!* For more effective flushing of the eyes, use the fingers to spread apart and hold open the eyelids. The eyes should then be frequently "rolled" or moved in all directions.

Ingestion

In the event VORANATE T-80 Toluene Diisocyanates are ingested, have the affected person drink large amounts of water or milk, if available. Do *not*, however, encourage or induce vomiting! Immediately transport to a medical facility and inform medical personnel about the nature and extent of the exposure.

Note to Physician

Toluene diisocyanate (TDI), the principal active ingredient in VORANATE T-80 Toluene Diisocyanates, is a highly reactive and potentially hazardous material which can adversely affect or injure the eyes, the skin, and both the respiratory and digestive tracts, depending upon the avenue and extent of exposure. For additional medical information, contact The Dow Chemical Company emergency phone number: 517-636-4400, anytime.

Inhalation

Inhalation of vapors or mists of TDI can severely irritate the mucous membranes of the nose, throat, bronchi, and lungs and may cause respiratory sensitization. Overexposure may produce a variety of symptoms, a number of which may not manifest themselves for several hours. These include headaches, irritation of the upper and lower respiratory tract, tightness of the chest (including difficulty in breathing), deep coughing, and choking. Some individuals may also experience attacks of sinusitis, bronchitis, bronchial asthma, or other severe respiratory distress.

Treatment:

Patients should be kept calm and warm, but not hot. The severity of respiratory distress will determine the need for oxygen.

Skin

Although it is not likely to be absorbed in acutely toxic amounts, repeated or prolonged contact with TDI may cause irritation, redness, swelling, blistering, or burns. Also, direct contact may produce skin sensitization (e.g., contact dermatitis) and allergenic response.

Treatment:

In case of skin contact, immediately irrigate skin with running water for at least 15 minutes. Remove all contaminated clothing. Treat blisters and/or burns as you would thermal burns. Also, if skin sensitization or dermatitis develops, treat as you would any contact dermatitis.

Eyes

The effects of exposure to liquid TDI may vary from slight irritation (with possible tearing and a burning sensation) to impairment of vision.

Treatment:

While prompt and thorough washing may mitigate the effects of the initial exposure, provide further medical treatment as appropriate.

Ingestion

Although TDI has a low level of acute oral toxicity, undiluted TDI is corrosive and can severely irritate or burn the mucous membranes of the mouth, esophagus, and stomach. Such injury may result in stricture or stenosis.

Treatment:

An initial or "first aid" response calls for the administration of large amounts of water or milk. Do *not*, however, encourage or induce vomiting. If gastric lavage is performed, suggest endotracheal and/or esophagoscopic control. No specific antidote is known. Treatment should be based on the judgment of the physician and individual patient response.

PART TWO

Shipment, Handling, and Storage

Shipment and Handling

General Specifications for Tank Trucks and Tank Cars

VORANATE T-80 Toluene Diisocyanates are classified by the Department of Transportation as Class B Poisons, and are, therefore, shipped in specially designed tank trucks and tank cars. Table 4 and Figures 4 and 5 contain general specifications for vehicles used by The Dow Chemical Company for the bulk shipment of VORANATE T-80 Toluene Diisocyanates.

Unloading Procedures

VORANATE T-80 Toluene Diisocyanates are classified as hazardous materials under the Department of Transportation's "Hazardous Materials Regulations." Thus, the unloading of tank trucks and tank cars must be done in strict accordance with those regulations. Some, but not all, of those regulations are given below.

Tank Trucks

VORANATE T-80 Toluene Diisocyanates are shipped in pressurized and insulated stainless steel tank trucks, equipped for bottom unloading only. Dow recommends that only DOT specification MC 304 or 307 tank trucks be used. Only properly trained and equipped personnel should be permitted to unload tank trucks. Operators should wear an appropriate respiratory protective device and impervious clothing, footwear, and gloves.

Table 4 — General Specifications (Tank Trucks and Tank Cars)

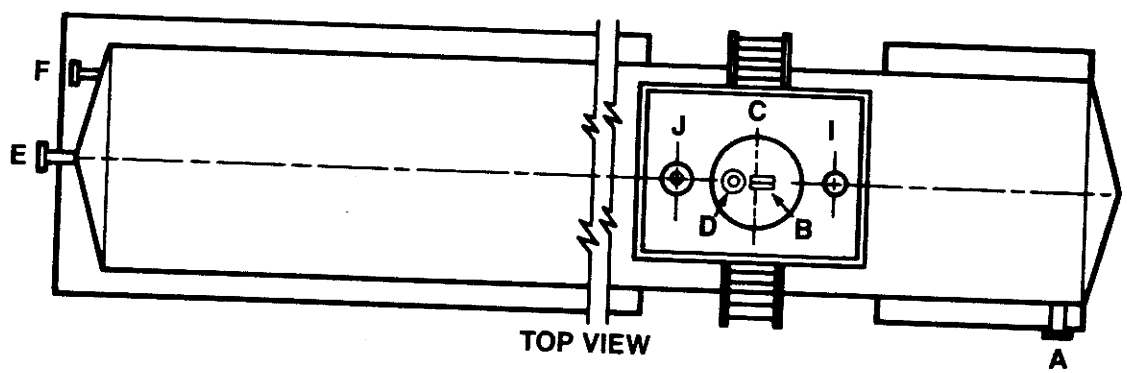
Details	Tank Trucks	Tank Cars
Capacity, Gallons	6,000	10,800 17,300
Capacity, Approximate Weight, lbs	42,000	104,000 172,000
Construction Material	Stainless Steel	Baked Phenolic Lined
Temperature Gauge	Yes	Thermowell
Pressure Gauge	Yes	No
Nitrogen Pad during Shipping	Yes	Yes
Nitrogen Pad Connection Size, Type	¾", QC[1]	2", Flange
Top Unloading	No	Yes
Top Unloading Connection Size, Type	None	2", Flange
Bottom Unloading	Yes	No
Bottom Unloading Connection Size, Type	3", MPT[2]	None
Unloading Pressure, psig	25 max	25 max
Steam Plates	Yes	Yes
Steam Plate Connection Size, Type	¾", MPT	2", Screw
Steam Pressure, psig	15	25

[1]Quick Connect
[2]Male pipe thread. Can be reduced to 2" with adapters.

Read and follow carefully each of the safety recommendations and precautions listed below:

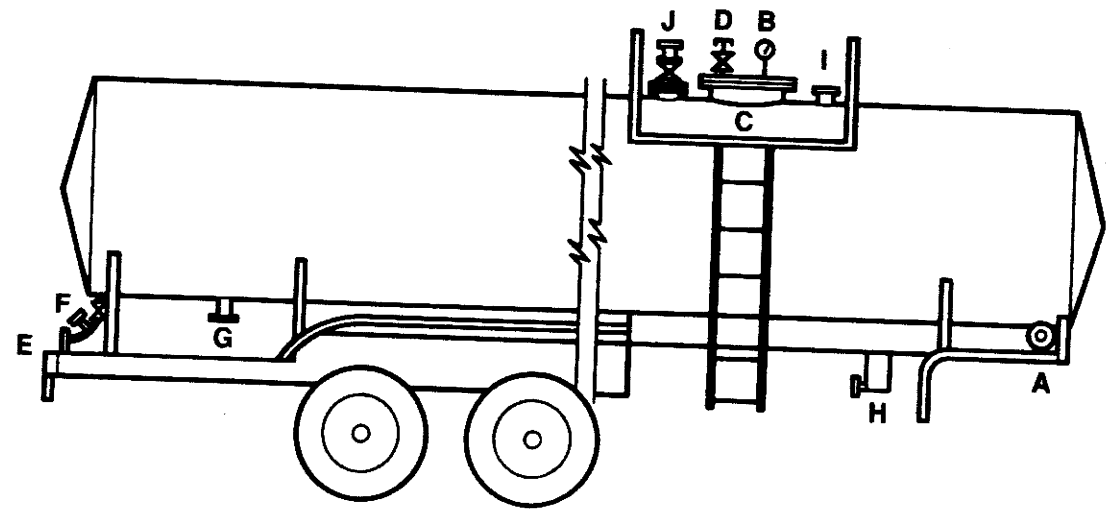
1. Before attempting to use the following procedure, operators should be thoroughly familiar with the potential hazards associated with the handling and storage of TDI.
2. Position the trailer as level as possible and block the wheels.
3. Carefully check the storage tank into which the contents of the truck are to be unloaded to be certain that it contains the intended VORANATE T-80 Toluene Diisocyanate product and *not* some other chemical or compound. Also, check the gauge on the storage tank to be sure that there is sufficient room to receive the entire contents of the tank truck.
4. Check all "product identification" or "bulk" tags (usually attached to product outlets, valves or seals) to be certain that the product being unloaded is, in fact, the intended VORANATE T-80 Toluene Diisocyanate.
5. Check the temperature of the contents. The temperature must be *above* 60°F (16°C) when the trailer is unloaded.

Figure 4 — Tank Trucks



TOP VIEW

A — ¾" Steam Inlet
B — 35# Safety Valve and Pressure Gauge
C — Manhole
D — ¾" DRY AIR/NITROGEN CONNECTION
E — 3" Unloading Connection
F — ½" Sample Valve
G — Steam Outlet
H — Air Dryer
I — 2" Loading Line
J — 2" Vent Line



SIDE VIEW

6. If heating is required, attach a 25 psi steam supply to the heating coil inlet connection. For better control of the heating process, use a steam pressure of 15 psi. Attach a steam trap, designed for the steam pressure available, to the heating coil outlet connection. Internal coils are not advised because of severe effects due to possible water contamination of the product. Allow the contents to warm until the temperature is at least 68°F (20°C). When the temperature reaches 68°F (20°C), turn off the steam and disconnect the lines. To prevent the heating coils from freezing during cold weather, be sure to drain them or "blow them out." CAUTION: Carefully watch the thermometer during heating. Do *not* allow the temperature to rise above 104°F (40°C). See "Temperature Control," page 8.

7. Attach the unloading line. The line should be clean, dry, and preferably made of flexible metal or either Teflon[1] fluorocarbon or Viton[1] fluoroelastomer hose which can safely withstand unloading pressures.

8. Connect the dry purge gas (preferably nitrogen) line to the tank truck. This line should have a pressure gauge, a safety valve set at 30 psig, and a pressure regulator set at 25 psig.

9. Draw off a sample of the contents for analysis. A sample of the contents may be obtained by connecting stainless steel tubing to the sample connection. Flush the sample connection by drawing off at least one gallon of product into a clean, dry container. The sample to be analyzed may now be drawn off into another clean, dry container of whatever size is necessary for testing. **WARNING:** Do *not* breathe vapors. Wear proper protective equipment, including an approved respiratory protective device.

[1]Trademarks and products of E.I. du Pont de Nemours Co., Inc.

10a. *If the contents are to be unloaded by purge gas pressure alone*, the storage tank should be fitted with a vent scrubber. This will prevent vapors from being vented into the atmosphere during unloading. (CAUTION: Do *not* exceed 25 psig purge gas pressure to unload the tank truck.) When the tank truck is empty, the pressure gauge will show a drop in pressure. Close the valve at the storage tank connection *first*. Then close the truck unloading valve.

10b. *If the contents are to be unloaded by pump*, either a vapor line connecting the storage tank vent to the tank truck should be installed (closed loop) or a low-pressure, replenishable gas pad must be placed on the tank truck. If a gas pad is used, install a vent scrubber on the storage tank vent. These precautions will not only prevent isocyanate vapors from being vented to the atmosphere, but will prevent a vacuum from being pulled on the tank truck during unloading. (CAUTION: Do *not* use a closed loop system unless the dead air space in the storage tank is free of moisture; i.e., – 40°F (– 40°C) dew point. Also, connection hoses should be purged with dry air or nitrogen before hookup.) When the trailer is empty, allow the unloading hose to vent down to the storage tank. Be sure to close the valve at the storage tank connection *first*. Then close the tank truck unloading valve.

11. Shut off the purge gas to the tank truck. Close the tank truck purge gas valve and disconnect the purge gas line. If a closed loop system was used in conjunction with pump unloading, close the tank truck connection valve and the tank vent valve. Then disconnect the hose connecting the two. All connection hoses should now be cleaned, dried, and capped for storage.

CAUTION: Unloading must be *closely monitored*, particularly if there is no automatic "cut off" in the unloading line. For example, if gas flow is allowed to continue after unloading, the gas flowing into the storage tank could rapidly increase internal pressure. This could cause serious structural damage to the storage vessel.

The tank truck should *not* be cleaned by the customer, nor should the manway be opened for inspection. The cleaning and inspection of the tank truck should be handled by the shipper under carefully controlled conditions, designed to safeguard personnel and equipment. **WARNING:** Under no circumstances should personnel enter any "empty" tank truck.

Tank Cars

VORANATE T-80 Toluene Diisocyanates are shipped in insulated, baked-phenolic-lined tank cars, equipped with external heating coils and a safety relief valve set for 75 psi. Tank cars from The Dow Chemical Company can be unloaded only from the top. Also, only properly trained and equipped personnel are permitted to unload tank cars. Operators should wear an approved respiratory protective device, eye protection, and protective clothing, footwear, and gloves.

Read and follow carefully each of the safety recommendations and precautions listed below:

1. Before attempting to use the following procedure, operators should be thoroughly familiar with the hazards associated with the handling and storage of VORANATE T-80 Toluene Diisocyanates. Also, see page 25 for a diagrammatic drawing of a typical tank car. (Note: All letter references refer to this drawing.)

2. Verify that the proper car is being unloaded. Carefully check the car number, product identification, and commodity stenciling against the bill of lading or other appropriate document. Also, sample the contents to be sure that the material is indeed a VORANATE T-80 Toluene Diisocyanate. Product identification and information tags are attached to the metal seal.

3. Position the car on the selected siding; then set the brakes and block the wheels.

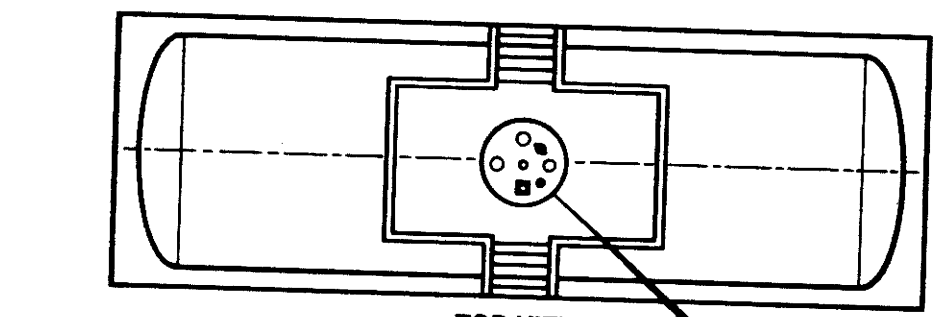
4. Position caution signs on the track or car in such a way as to give adequate warning to persons approaching the car from the open end(s) of the siding. CAUTION: The signs should *not* be removed until the car has been unloaded and disconnected from the discharge connection. Code of Federal Regulations, Title 49, "Hazardous Materials Regulations of the Department of Transportation," Section 174.67, "Tank Car Unloading," states, in part, that:

The signs must be of metal or other comparable material, at least 12 inches high by 15 inches wide in size, and bear the words, "STOP — Tank Car Connected," or "STOP — Men at Work," the word "STOP" being in letters at least 4 inches high and the other words in letters at least 2 inches high. The letters must be white on a blue background.

In addition to these mandatory regulations, The Dow Chemical Company recommends that the switch(es) on the open end(s) of the siding be provided with locks, or that derails be placed on the track at least 50 feet from the end(s) of the car. This should effectively prevent the entry of other cars into the siding where the isocyanate is being unloaded. CAUTION: In the event derails are used, be sure to attach a signal flag to the track to indicate that the derail is in position. Also, attach a signal light to the flag at night.

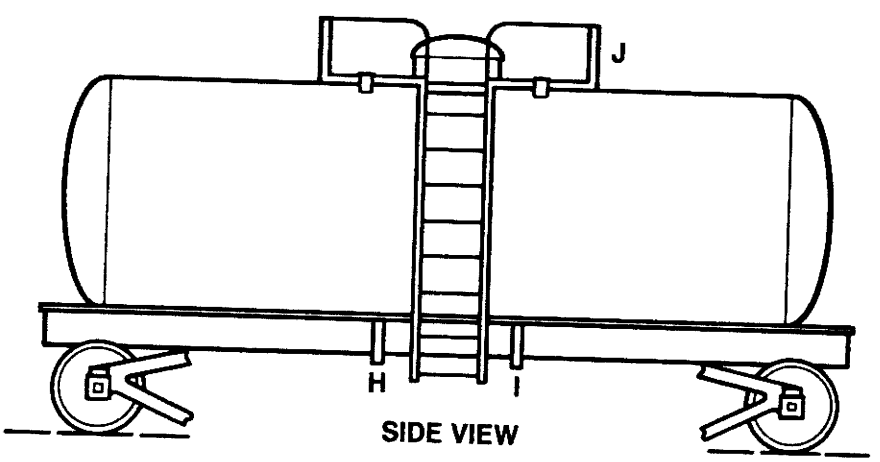
Figure 5 — Tank Car

Note: On some 17,000-gallon DOWX series cars there is a variation in the dome valving configuration. The diagram below shows the normal configuration. However, in some cars the positions of A (the gauging device) and C (the 75# safety valve) are reversed.



TOP VIEW

A — Gauging Device
B — ¾" Thermowell
C — 75# Safety Valve
D — 2" Top Unloading Valve
E — 2" Pressure Connection
F — ¼" Sample Valve
G — 2" Top Unloading Valve
H — 2" Steam Coil Outlet
I — 2" Steam Coil Inlet
J — Safety Platform



SIDE VIEW

5. Climb the ladder to the platform area on top of the car. All unloading apparatus on Dow tank cars is located in the manway bonnet in the center of the platform. Remove the seal from the latch pin and open the bonnet dome. When the cover is open, check to see that all valves are in the closed position.

6. Check the temperature of the tank car by removing the ¾-inch cap from the thermowell (B) and inserting a thermometer approximately 24 inches for 15-20 minutes. The temperature of the contents must be above 60°F (16°C) when the car is unloaded.

7. Should heating be necessary, remove the cover from the magnetic gauge (A) and raise the gauge rod to where the magnet in the end of the rod engages the magnet on the float. The rod is calibrated in ¼-inch increments and should read between 4 and 7 inches. Next, attach a steam hose to the steam inlet connection located on the bottom of the car. Attach a steam trap, designed for the steam pressure available, to the heating coil outlet connection. For greater control of the heating process — that is, to avoid hot spots and product deterioration — use a steam pressure of 25 lbs or less. Also carefully monitor the outage to be sure that expansion does not fill the car "liquid full" and cause it to "pressure relieve" through the safety valve. Finally, be sure to monitor the pressure on the tank car during heating. Do *not* allow pressure to go beyond 30 psig. Also, dry nitrogen is recommended for padding.

8. Allow the contents to warm until the temperature is at 68°F (20°C). When the temperature reaches 68°F (20°C), turn off the steam, disconnect the lines, and allow the heater coils to drain. CAUTION: Carefully watch the thermometer during heating. Do *not* allow the temperature to rise above 104°F (40°C).

9. Connect flanges holding vents or vapor lines (E) as follows:

   a. Use the proper wrenches to remove the bolts. Both the vent and load/unload valves are equipped with 2-inch ASA Series 15 flanges with four bolts in a 4¾-inch bolt circle. Although these are combination flanges to which a screw-type hookup may be made (e.g., by removing the 2-inch solid plug instead of the flange), it is strongly recommended that a flanged connection be used. Use an open-end wrench of proper size to hold the nut on the bottom of the flange and a box-end or socket wrench to turn the bolt on the top side of the flange. Pipe or other adjustable wrenches are *not* recommended. The bolts away from the operator should be removed *first*.

   b. Carefully connect the purge line to the valve by reinstalling the gasket and bolts.

   c. Tighten opposite bolts with equal pressure until all bolts are uniformly tight.

   d. Equip the purge line connection with a pressure gauge regulated to a maximum pressure of 40 psig.

10. If desired, a sample of the contents may be drawn off through the sample valve (F), which is a ¼-inch needle valve equipped with standard pipe threads. (Note: If a sample is desired from an unpressured car, use 3 to 4 lbs of purge gas pressure.) The sample valve is attached to a sample line, which is equipped with an excess flow valve. Should the excess flow valve close, turn off the sample valve. Wait approximately one minute; then reopen the sample valve. If the excess flow valve does not reopen, it may be necessary to rap with a ball-peen hammer against the manway cover plate near the sample valve to cause the ball in the excess flow valve to drop into the open position. A good preventive practice against excess flow valve closure is to draw the sample very slowly. **WARNING:** Do *not* breathe vapors. Wear proper protective equipment, including an approved respiratory protective device.

11. Attach the unloading line(s) (which should be clean, dry, and preferably made of flexible metal or either Teflon fluorocarbon or Viton fluoroelastomer hose which can safely withstand unloading pressures) to the unloading valve(s) (D and G). Follow the procedure outlined under Step 9. After proper attachment of the unloading line(s), slowly open the unloading valve(s) until discharge line(s) is liquid full.

12. Pressure on the car may now be increased to discharge the product. Be sure, however, that the amount of pressure is appropriate to the unloading method used (i.e., by purge gas pressure or pump). If the contents are to be unloaded by purge gas pressure alone, the storage tank should be fitted with a vent scrubber. Also, storage tank pressure should be carefully controlled and monitored during the unloading operation.

13. When the tank car is empty, the unloading lines should be blown clear of liquid and blocked in before being disconnected. See Step 14d. There are a number of ways to determine when the tank car is empty. For example, a rapid drop in pressure on the car would indicate that the liquid is gone and that the gas is blowing out through the unloading line. The amount of product received into the storage tank should also indicate whether or not the tank car is empty. CAUTION: Do *not* use the Magnetic Gauging Device to determine if the car is empty. This device only extends 60 inches into the car, the car itself is 102 inches in diameter. Also, do *not* breathe vapors. Wear proper protective equipment, including an approved respiratory protective device, when disconnecting the lines.

14. Once the tank car is empty, return all valves and connections to their original condition:

    a. Remove the thermometer from the thermowell and replace the dust cap.

    b. Completely lower the Magnetic Gauging Device and replace the dust cap.

    c. Close the sample valve and replace the ¼-inch plug.

    d. Liquid unloading lines should be blown dry and disconnected in accordance with the following sequence: First, blow the line to the storage tank; then close off the valve to the storage tank. Second, open the unloading valve on the tank car and blow any material left in the line back into the car. Next, determine the amount of pressure remaining in the car. If it is below 10 psig, continue flow of purge gas until pressure in the car reaches a minimum of 10 psig. (Note: Do *not* allow pressure to exceed 40 psig.) Now close the tank car valve, bleed off any pressure left in the unloading line, and remove the bolts. To prevent residual material or pressure from blowing toward the operator, be sure to remove the bolts away from the operator *first*. Finally, replace the gasket and flange on the unloading valve. Alternately tighten opposite bolts until all bolts are uniformly tight and a leak-proof seal has been made.

    e. Remove the purge gas line and replace the gasket and flange.

    f. Close dome cover and replace latch pin. It is recommended that the pin be sealed to preclude its removal during transit.

    g. If any car defects are found, note them on the standard "Bad Order" tag and attach the tag to the dome cover latch pin.

    h. If steam is used, do not replace inlet and outlet plugs on the heater coils. This will allow drainage.

15. Code of Federal Regulations (CFR), Title 49, "Hazardous Materials Regulations of the Department of Transportation," Section 174.69, "Removal of Placards and Car Certificates After Unloading," states, in part, that:

    When lading requiring placards or car certificates is removed from a rail car other than a tank car, each placard and car certificate must be removed by the person unloading the car. For a tank car which contained a hazardous material, the person responsible for removing the lading must assure, in accordance with the provisions of Section 172.510(c) of this subchapter, that the tank car is properly placarded for any residue which remains in the tank car.

    Section 172.510(c), "Special Placarding Provisions: Rail," states, in part that:

    Each tank car containing the residue of a hazardous material must be placarded with the appropriate RESIDUE placards, as required in Section 172.525 and paragraph (a) of this section. The RESIDUE placard must correspond to the placard that was required for the material the tank car contained when loaded, unless the tank car —

    (1) Is reloaded with a material requiring no placards or different placards; or

    (2) Is sufficiently cleaned of residue and purged of vapor to remove any potential hazard.

    Section 172.525, "Standard Requirements for the RESIDUE Placard," states, in part, that:

    (a) Each RESIDUE placard must be as follows:

    (1) The triangle at the bottom of the placard must be black. The word "RESIDUE" must be white.

    (2) The midsection and upper triangle on the RESIDUE placard must be as specified in Section 172.519 and Appendix B to this part, and . . . as appropriate for the residue of the commodity being transported and required by this subchapter to be placarded.

    (b) The top part of each RESIDUE placard must be as specified in Appendix B to this part and as illustrated on the POISON — RESIDUE placard which, except for size and color, must be as follows:

    (c) The RESIDUE placard must be as shown in paragraph (b) of this section and may be —

    (1) A separate placard,

    (2) On the reverse side of a placard, or

    (3) A composite made by covering the bottom triangle of the appropriate placard with a black triangle bearing the word "RESIDUE" in white letters.

16. Remove warning, open derails, unlock switches, etc. Release hand brakes and remove chocks from wheels. If an unloading rack was used for entrance to the dome platform, be sure that all parts of the rack are removed and relocated far enough away from the car to conform to AAR specified clearance for entry of the rail crew for switching operations.

17. Complete all final paperwork (e.g., "Empty Return Instructions"). After all forms have been completed and the proper carrier endorsements obtained, send the various copies to the locations designated in the instructions.

    Unloading must be *closely monitored*, particularly if there is no automatic "cut off" in the unloading line. For example, if gas flow is allowed to continue after unloading, the gas flowing into the storage tank could rapidly increase internal pressure. This could cause serious structural damage to the storage vessel.

Drums[1]

VORANATE T-80 Toluene Diisocyanates are shipped in DOT specification phenolic-lined steel drums or high-density polyethylene drums that are authorized for TDI. Drums are equipped with two bungs on the top.

[1]Currently, in the U.S.A., VORANATE T-80 Toluene Diisocyanates are available only in bulk quantities (i.e., in tank truck or tank car shipments).

Read and follow carefully each of the safety recommendations and precautions listed below:

1. Closely examine each shipment for damaged drums. Drums should be handled and unloaded carefully to prevent damage. If damaged drums are found, they should be closely inspected for leaks. Leaking drums should be removed to a well-ventilated area and the contents transferred to other suitable containers. The empty drums should be decontaminated (see page 13) and then holed or crushed so they cannot be reused.

2. Drums may be unloaded with conventional stainless steel drum pumps. To prevent collapse of the drum during unloading, equip the drum vent with a dry air or dry nitrogen breather. This attachment will also prevent moisture contamination of the contents. When not in use, pump lines should be protected from moisture by fitting a plug or cap into the open end. Portable pumps, lines, and fittings, should be carefully rinsed, dried, and stored in a dry location. See "Moisture Control," page 7. CAUTION: Operators engaged in handling, opening, unloading, and closing drums should be completely familiar with the hazards associated with isocyanates and should be properly equipped with protective clothing and an approved respiratory protective device.

Storage

Drum Storage

Whenever possible, drums containing VORANATE T-80 Toluene Diisocyanates should be stored indoors. During cold weather, the temperature in storage areas should be kept above 68°F (20°C). If drums are received frozen, be sure the contents are completely thawed and mixed before using. Thawing may be accomplished by allowing the drums to sit in a warm storage area or by using a drum heater. CAUTION: Do *not* heat the contents above 104°F (40°C) or the drum wall above 175°F (79.5°C). Overheating may cause expansion of the contents, homopolymerization, and the subsequent formation of carbon dioxide, which can seriously weaken or completely rupture a drum. See "Temperature Control," page 8. During warm weather, drums may be stored outdoors. However, drums should be stored in such a manner as to prevent water from collecting on the tops. This may be accomplished by storing the drums under a cover or by stacking them on their sides.

Bulk Storage

A properly designed bulk storage system for VORANATE T-80 Toluene Diisocyanates must:

- Permit safe handling of the material,
- Provide both moisture and temperature control,
- Prevent contamination of the product, and
- Minimize the hazards of combustibility.

Before attempting to construct such a system, therefore, it is essential that designers familiarize themselves with the hazards, safety recommendations, and precautions associated with the handling and storage of VORANATE T-80 Toluene Diisocyanates. A genuinely practical design must not only include a physical layout of the facilities and equipment, but must also include a plan for personnel safety in all areas of the operation. In short, the establishment of safe work procedures must be an integral part of *any* bulk storage system. In addition, designers must consider all applicable insurance requirements, as well as governmental codes and regulations, and should consult with all appropriate state and local agencies during each stage of planning and construction.

The equipment described below is suitable for use in bulk storage systems for VORANATE T-80 Toluene Diisocyanates. Such items, however, are merely components of typical systems and must not be considered a finished design. Also, other equipment similar to the items listed can be tested for performance and may give equally good results. See the lists of "Equipment Manufacturers and Suppliers" on pages 33-38.

Tanks

Tanks should be sized to meet plant and customer needs. Minimal capacity equivalent to 150% of normal monthly bulk receipt is suggested. Each storage vessel should be a welded, vertical or horizontal, cylindrical, carbon steel tank (A283C steel) built to API 650 Code and designed to hold the specified product safely when filled to capacity.

Both vertical and horizontal tanks should be equipped with the following openings:

1 — 20-inch of manway,

1 — 20-inch shell manway 12 inches off floor,

1 — 3- or 4-inch roof nozzle for vent,

3 — 1½-inch roof nozzles for gauge,

1 — 2-inch shell nozzle near floor leading to a dished sump for drain,

2 — 2- to 3-inch shell nozzle 12 inches above floor for inlet and outlet. Inlet and outlet are to be 90° apart, and

1 — 1-inch 3,000-lb coupling in shell 36 inches above floor for thermometer well.

Tank vents should be passed through an activated carbon bed prior to discharging to the atmosphere.

In the design of tanks to be lined, minimal radii recommended by the lining manufacturer must be observed. Full fillet interior welds should be utilized, and all splatter must be ground smooth. Welds must be continuous and smooth and should have no undercuts or porosity. The tank manufacturer should be responsible for providing the proper radii and welds and for removing all splatter. The lining contractor should be responsible for other surface preparation.

Tanks should be water-tested to design pressure, and then dried, brush sandblasted inside, and cleaned. A silica gel charge should be placed inside the tank prior to sealing it for shipment. Also, moisture content should be 125 ppm maximum prior to putting the tank into service. Exterior scale should be removed and the exterior primed with one coat of red inorganic zinc primer. Silica gel charges in tanks must be removed and the system must be thoroughly cleaned dried, and purged with a dry pad gas prior to use.

Linings

Linings are desirable to prevent the pickup of rust or iron which can cause product discoloration. If a lining is to be used, surface preparation and lining application are of prime importance and should be conducted in strict accordance with the lining manufacturer's recommendations. Also, only experienced lining applicators, who are licensed or approved by the lining manufacturer, should be considered for application work.

Surfaces should be prepared and coated within 8 hours, during which proper temperature and humidity control should be maintained. In no case, however, should a lining application be attempted on a surface once evidence of rust has been detected. Also, if linings are applied in the shop, extra care must be exercised to prevent lining damage during transportation and erection of the tank. If any damage does occur, it should be thoroughly repaired prior to placing the tank in service. High-temperature baked-phenolic lining is satisfactory for storage of VORANATE T-80 Toluene Diisocyanate, provided proper application and curing methods are employed. Other satisfactory lining materials include the following: Heresite[1] P403-L66; Bisonite[2] 957; Plasite[3] 3055, 3066 or 7122; Colturiet Phenguard[4] 7436 and equivalent materials.

[1]Trademark of Heresite-Saekaphen, Inc.
[2]Trademark of Bisonite Company, Inc.
[3]Trademark of Wisconsin Protective Coating Corp.
[4]Trademark of Sigma Coatings, Inc.

Insulation

Storage tanks located out-of-doors and which may be exposed to extremes of temperature should be insulated with either a 1- or 1½-inch thick polyurethane foam or STYROFOAM* Brand Plastic Foam, or a 2-inch thick fibrous glass. Insulation must be sealed to prevent the collection of moisture, which could corrode the external tank wall. In addition, an effective weather cover should be used to protect the tank from rain, snow, ice, etc.

If tanks are located indoors, where normal room temperatures are maintained, insulation may not be necessary. Interior storage tanks insulated with plastic foam should be covered with an effective flame barrier to minimize the hazard of combustibility. To prevent lining damage, insulation and any necessary welding should be completed before the lining is installed.

Pumps

Steel or stainless steel standard centrifugal or positive displacement pumps equipped with mechanical seals are preferred. Sealless pumps (such as Crane Chempump[1]) and magnetic drive pumps (such as Kontro[2] and Magnatex[3]) are also satisfactory. Do *not* use silicone greases. Also, mechanical seals should be purged with dry gas to prevent moisture from contacting the seal face and causing urea formation and seal failure.

Depending upon preferred flow rates, two pumps for each system may be desirable. Truck unloading pumps should have a capacity of 100-150 gpm. Lower rates, however, may be preferred for process pumps. If so, two suitably sized pumps should be used.

Relief Valves

Three types of valves are required:

- Pressure-vacuum (P-V) vents for tanks,
- Relief valves for positive displacement pumps, and
- Line relief valves.

*Trademark of The Dow Chemical Company

[1]Trademark of Crane Company
[2]Trademark of The Kontro Company
[3]Trademark of Bullen Pump and Equipment Company

Each storage tank must be provided with a pressure-vacuum (P-V) vent valve which, to prevent accumulation of vapors, should relieve or terminate out-of-doors.

Also, provided that all parts and equipment are rated for a working pressure of 150 psig, each positive displacement pump should be equipped with a relief system set at a maximum of 125 psig. If parts and equipment are not rated at 150 psig, the relief should be set at 75% to 95% of the system's lowest working pressure.

Finally, each line section which can be closed off by valves while full of liquid should have a relief valve which relieves back toward the tank, with the final section relieving into the tank itself. Settings for these reliefs should be the same as those for pumps.

Pressure Gauges

Gauges should be provided at the pump, before and after filters, and near the process. They should be protected by a sealed diaphragm filled with nonhydrocarbon fluid. Gauges are also advisable on steam and air lines and on equipment where gases or liquids are handled, such as chillers and heat exchangers.

Sample Valves

To facilitate product sampling, ½- to ¾-inch sample valves, which terminate in a stainless steel nipple, should be provided in each system.

Piping

Both schedule 40 seamless carbon steel pipe (A53) and welded pipe joints with flanges and flanged valves work well. Threaded couplings and valves may also be used, provided that tape made of Teflon brand fluorocarbon fiber is used on all threaded fittings. Tape must be applied carefully. Also, *no* pipe dopes may be used.

Selection of line sizes will be determined by product flow rate, system design, and pump specifications. Normally, a line 3 inches in diameter is satisfactory; however, for short, simple systems, 2 inches may be more suitable, while for longer and more complex systems, 4 inches may be required. In any event, sizes should be established in conjunction with the pump supplier, keeping the diameter to the practical and economical minimum.

Pipeline insulation and heating or cooling may be required if lines are either outdoors or in an area where normal room temperatures are not maintained.

Heating

VORANATE T-80 Toluene Diisocyanates should be maintained at slightly above room temperature (i.e., 70°-90°F [21°-32°C]). Care should be taken to prevent the product from overheating to above 104°F (40°C). For heating uninsulated indoor storage tanks, an industrial heater may prove adequate. However, for outdoor insulated tanks, external plate coils using steam to 25 psig are recommended. To maintain suitable product temperatures, pipelines may also require insulation, tracing, or both.

Heat Exchangers

Heat exchangers should have an area of 2 to 3 square feet per gallon/minute.

Pad Gas

Dry nitrogen is preferred; however, dry, oil-free air supplied by an air compressor and dryer may also be used. Either gas should have a maximum dew point of −40°F (−40°C). It is very important that TDI tank atmospheres be kept dry. If wet air is allowed to enter the tank, solid ureas will be formed. Over a period of time, a substantial amount of solids can accumulate.

Pressure Control Valves (PCV)

Use a low-pressure regulator to control the pressure in the isocyanate storage tank.

Temperature Indicators (TI)

The temperature of the product may be accurately monitored with a dial-type thermometer inserted in a suitable thermowell. To achieve greater heat transfer for a more accurate reflection of the temperature of the contents, be sure the thermometer is in direct contact with the thermowell.

Level Indicators (LI)

A level indicator should be used to measure product level in the tank and to determine inventory.

Strainers

Steel-cased, dual-line strainers having 100-mesh stainless steel reinforced wire screen baskets are recommended. Units should also be equipped with block valves which permit one side to continue in operation while the other is being serviced. It is strongly recommended that all unloading and process lines be equipped with either strainers or filter; e.g., use strainers on the unloading lines close to the tank and filters on the process lines close to the process.

Filters

Filters should be equipped with elements which are suitable to the product and the desired flow rate. Twenty-micron, cotton-wound elements with voile-covered steel mesh cores are recommended.

Meters

Use suitably sized meters. Meters should contain no aluminum or aluminum alloys nor any synthetics other than Teflon fluorocarbon and Viton fluoroelastomer. Turbine meters equipped with totalizers have proved satisfactory.

Valves

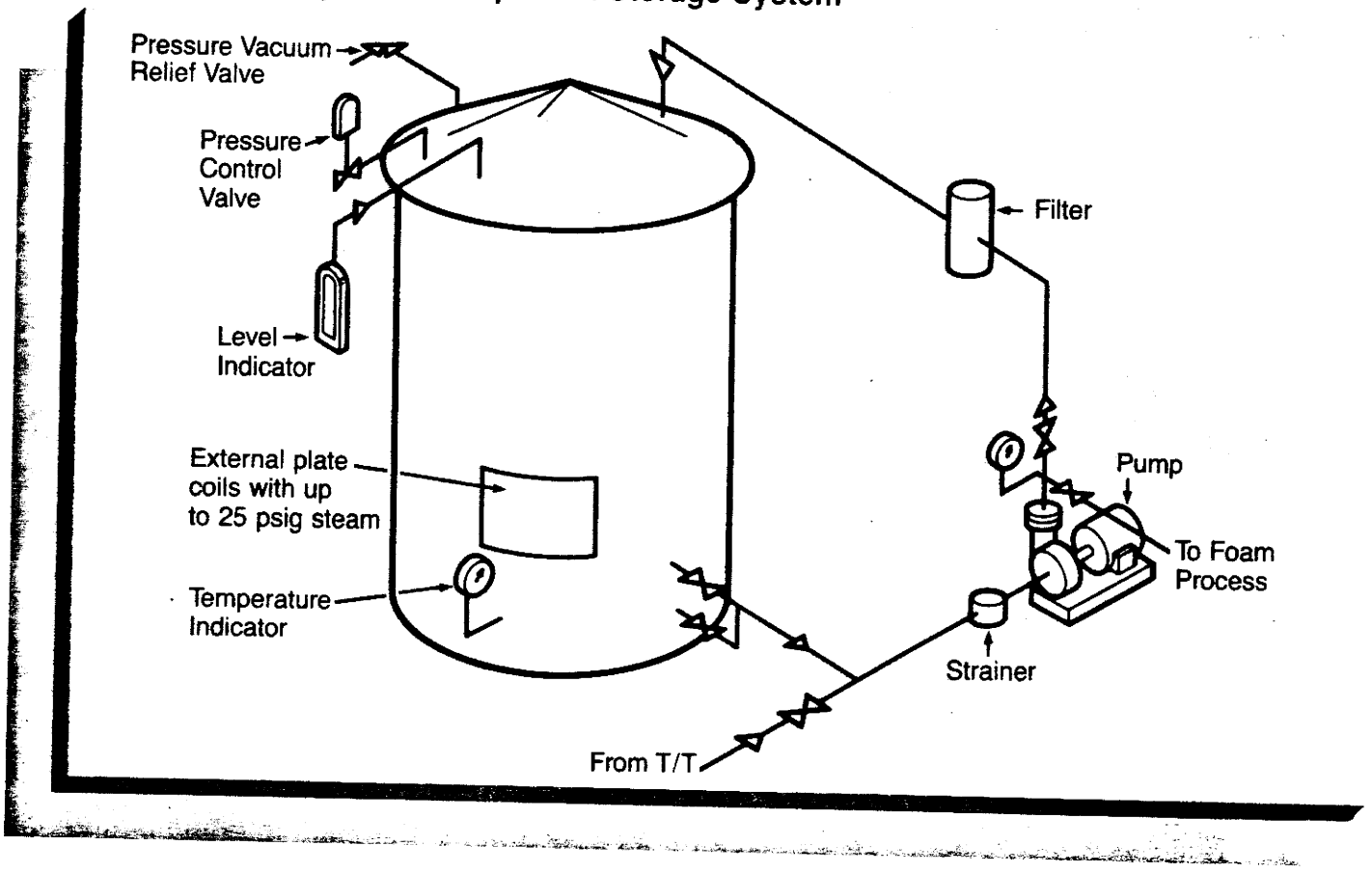
Cast steel, malleable iron, or 316 stainless steel 150 psig valves are suitable for tank nozzles. Steel, malleable iron, or iron 125 psig valves may be used on lines. Also, gate, ball, or plug valves may be used, provided no internal lubrication is required. Valve packing, if required, should be non-graphited asbestos, asbestos impregnated with Teflon fluorocarbon fiber, or braided Teflon fluorocarbon fiber. Also, ball valves should have seats of Teflon.

Gaskets

Gaskets of nongraphited asbestos, asbestos impregnated with Teflon fluorocarbon, or braided Teflon fluorocarbon fiber may be used. Spiral-wound Teflon filled gaskets and Garlock Gylon[1] Blue have also proved satisfactory.

[1]Trademark of Garlock Inc.

Figure 6 — Isocyanate Component Storage System



Hoses

Hoses should be made of either Teflon fluorocarbon or Viton fluoroelastomer. Hoses for permanent and continuous service should be made of flexible seamless metal, steel, or stainless steel.

Electrical

Explosion-proof wiring and equipment should be used in all areas where flammable vapors or dusts are likly to be present. Also, all electrical equipment should be grounded.

Electrical work must conform to all applicable codes and ordinances. When ordering electrically operated equipment, be sure to specify the type of electrical service available.

Foundations

Depending upon load and soil conditions, reinforced concrete pads, concrete rings, reinforced concrete piers, or crushed stone rings may be used. Vertical tank bottoms should be coated and, if out-of-doors, sealed to the foundation with asphalt. Also, if ring foundations are used, the centers should be filled with compacted oiled sand.

Paint

All steel equipment used out-of-doors should be carefully cleaned and coated with a suitable primer.

Dual-Service Equipment

Equipment to be used for two or more products must be so designed that it can be drained and blown dry between products. Manifolds should *not* be used. Instead, switch-hose and quick-coupler connections should be made between dual service equipment and individual product lines.

Drains

All equipment should be provided with drains and should be designed to drain completely. Piping should slope toward low points equipped with drains. Tank areas should be diked; however, there should be no open drains within the diked area.

Ventilation

Indoor storage systems should be housed in a separate room, equipped with exhaust fans and intakes. This will minimize vapor accumulation in the event of a leak or spill.

Miscellaneous

- Waste control, disposal, and air pollution control measures should be carefully considered. Proper systems and operational controls should be instituted and carefully maintained.
- All equipment and facilities, as well as their installation, should conform to the specifications and requirements of appropriate federal, state, and local codes and ordinances.
- All equipment and materials should be compatible with the product to be handled and should be installed in strict compliance with the manufacturer's recommendations.
- All systems should be bonded and grounded. Bonding and grounding cables should be available at all loading and unloading stations.
- All electrical equipment, such as motors, switches, etc., as well as their installation and use, must conform to codes established by Underwriters Laboratories (UL).
- All tanks should be equipped with a stripping connection so that the tank may be completely emptied for cleaning, inspection, or repair.
- All liquid bulk storage systems should be hydrostatically tested prior to lining, insulation, or use.
- All systems, new or old, should be provided with adequate waste control and disposal facilities, as well as sources of air, water, steam, and electric power for both systems operation and cleaning.

CAUTION

- Toxicology: Virtually all chemicals possess some degree of toxicity. Before handling a new chemical, therefore, it is essential that its toxicological properties as well as any potential hazards associated with its handling and use, be thoroughly studied and understood. Based upon this study, appropriate health and safety standards should then be established and maintained. Be sure to obtain a copy of the current Material Safety Data Sheet (MSDS) for the appropriate VORANATE T-80 Toluene Diisocyanate. Copies are available upon request from any Dow sales office or from The Dow Chemical Company, Plastics Group, 2040 Willard H. Dow Center, Midland, MI 48674.
- Isocyanate: Equipment containing copper, zinc, or tin, or their alloys, including brass, bronze, or galvanized materials, should *not* be exposed to liquid isocyanate or its vapors. Also, do *not* expose either rubber or synthetics — except Teflon fluorocarbon or Viton fluoroelastomer — to isocyanate liquid or vapor.
- Silica gel charges: Silica gel charges in tanks must be removed and the system must be thoroughly cleaned, dried, and purged with a dry pad gas prior to use.

APPENDIX A

Equipment Manufacturers and Suppliers: Bulk Handling and Storage Equipment

The following list is representative of manufacturers and suppliers of equipment who may be used in the design and construction of systems for bulk handling and storage of VORANATE T-80 Toluene Diisocyanates. Specific questions about the specifications or suitability of any of the products offered by these firms should be addressed to the firm in question[1]. The Dow Chemical Comnpany neither endorses the products offered nor guarantees their performance. Reference to a company or product by name does not imply approval or recommendation by Dow of any product to the exclusion of others that may be suitable for the intended purpose.

[1]The names, addresses, ZIP codes, and telephone numbers listed here are accurate as of the date of publication. For current information, consult *Thomas Register, Standard & Poor's,* or the *Dun & Bradstreet Reference Book of Manufacturers.*

Couplings-Quick

Dover Corp., OPW Div.
277-T Park Avenue
New York, NY 10172
212-826-7160

Ever-Tite Coupling Co., Inc.
256 W. 54 St.
New York, NY 10019
212-265-1420

Drum Filling

Crandall Filling Machinery, Inc.
P.0. Box 706-T
Buffalo, NY 14217
716-885-2228

Dryers

Lectrodryer Div.
(Ajax Magnethermic Corp.)
P.0. Box 2500
Richmond, KY 40475
606-624-2091

Pall Pneumatic Products Corp.
2200 Northern Blvd.
East Hills, NY 11548
516-484-5400

Permea
11444 Lackland Road
St. Louis, MO 63146
314-694-0158

Sentry Tank Accessories, Inc.
3800 N. Carnation Street
Franklin Park, IL 60131
312-671-1500

Filters

Commercial Filters Div.
(A Sohio Company)
State Rte., 32 W.
P.0. Box 1300
Lebanon, IN 46052
317-482-3900

Cuno, Inc.
(Commercial Shearing, Inc.)
402 Research Pky.
Meriden, CT 06450
203-238-8716

Filterite Brunswick Corp.
Technetics Div.
2033 Greenspring Dr.
Timonium, MD 21093
301-252-0800

Millipore Corp.
80 Ashby Road
Bedford, MA 01730
617-275-9200

Ronningen-Petter Co.
(Div. Dover Corporation)
P.0. Box 188T
Portage, MI 49081
616-323-1313

Gaskets

Crane Packing Co.
6410 Oakton St.
Morton Grove, IL 60053
312-967-2400

Flexitallic Gasket Co.
P.0. Box 848
151 Heller Pl.
Bellmawr, NJ 08031
609-931-2500

Garlock Inc.
Mechanical Packing Division
(Colt Industries, Inc.)
1666 Division St.
Palmyre, NY 14522
315-597-4811

Manville
P.0. Box 5108
Denver, CO 80217
1-800-243-8060

Gauges, Pressure

Ametek, Inc.
U.S. Gauge Div.
P.0. Box 152, Dept. TR
Sellersville, PA 18960
215-257-6531

Dresser Instrument Division
Dresser Industries, Inc.
250 E. Main St.
Stratford, CT 06497
1-800-243-8160

Grease Lubricants *(Solvent Resistant)*

Penreco
(A Pennzoil Division)
104 S. Main St.
Butler, PA 16001
412-283-5600

Heat Exchangers

ITT Standard
Heat Transfer Technology
175 Standard Pky.
Buffalo, NY 14227
716-897-2800

Nooter Corp.
P.0. Box 451
St. Louis, MO 63166
314-621-6000

Patterson-Kelly Co.
(Div. Harsco Corp.)
Thomas & Muth Sts.
East Stroudsburg, PA 18301
717-421-7500

Smithco Engineering, Inc.
P.0. Box 571330
Tulsa, OK 74157
918-446-4406

Struthers Wells Corp.
1003-T Pennsylvania W.
P.0. Box 8
Warren, PA 16365
814-726-1000

Vilter Mfg. Corp.
2217-T S. First St.
Milwaukee, WI 53207
414-744-0111

Heaters

Crane Company
(Cocrane Environental Systems Div.)
P.0. Box 191
King of Prussia, PA 19406
215-265-5050

Hose *(Metal)*

Aeroquip, U.S. Industrial Group
300 S. East Ave.
Jackson, MI 49203
517-787-8121

Federal Hose Manufacturing Corp.
P.0. Drawer 480
Painesville, OH 44077
216-352-8927 or 1-800-346-4673

Flexonics, Inc.
300-T E. Devon Ave.
Bartlett, IL 60103
312-837-1811

Penflex Inc.
271 Lancaster Ave.
Frazer, PA 19355
215-644-7400 or 1-800-232-3539

Universal Metal Hose Co.
2135 S. Kedzie Ave.
Chicago, IL 60623
312-277-0700

Hose *(Synthetic)*

Goodall Rubber Co.
P.0. Box 8237-T
Trenton, NJ 08650
609-587-4000 or 1-800-524-2650

The Goodyear Tire & Rubber Co.
Industrial Products Div.
P.0. Box 52-T
Akron, OH 44309
216-796-2204

R. M. Engineered Products
P.0. Box 5205
North Charleston, SC 29406
803-744-6261

Uniroyal, Inc.
Product Information Center
World Headquarters
Middleburg, CT 06749
203-573-3717

Hose Reels

Hannay, Clifford B. & Son, Inc.
700 E. Main St.
Westerlo, NY 12193
518-797-3791 or 1-800-982-0030

Insulation

The Dow Chemical Company
Plastics Group
2040 Willard H. Dow Center
Midland, MI 48674
517-636-1000

Pittsburgh Corning Corp.
800 Presque Isle Dr.
Pittsburgh, PA 15239
412-327-6100

Joints

(See "SWIVEL JOINTS")

Level Indicators

Emerson Electric Co.
8000-T. W. Florissant Avenue
St. Louis, MO 63136
314-533-2000

Level Indicators *(Magnetic)*

Midland Mfg. Corp.
7733-T Gross Point Rd.
Skokie, IL 60076
312-677-0333

Level Switches

Magnetrol International
5300 Belmont Rd.
Downers Grove, IL 60515
312-969-4000

National Sonics
(Div. of Xertex Corp.)
250-T Marcus Blvd.
Hauppauge, NY 11787
516-273-6600

Linings

Ameron, Inc.
(Ameron Protective Coatings Div.)
4700-T Ramona Blvd.
P.O. Box 3000
Monterey Park, CA 91754
213-268-4111

Bisonite Co., Inc.
2248-T Military Rd.
Tonawanda, NY 14150
716-693-6130

Heresite-Saekaphen, Inc.
822 S. 14th St.
Manitowoc, WI 54220
414-684-6646

Sigma Coatings, Inc.
P.O. Box 826, Dept. TR
Harvey, LA 70059
504-347-4321

Wisconsin Protective Coating Corp.
614 Elizabeth St.
Green Bay, WI 54305
414-437-6561

Meters

Brooks Instrument Div.
(Emerson Electric Co.)
407 W. Vine St.
Hatfield, PA 19440
215-362-3500

The Foxboro Company
86 Neponset Ave.
Foxbor, MA 02035
617-543-8750

Halliburton Services
(Div. Halliburton Company)
Drawer 1431
Duncan, OK 73536
405-251-3760

Liquid Controls Corp.
Dept. TR-31
Wacker Park
N. Chicago, IL 60064
312-689-2400

Rockwell International Corp.
(Measurement & Flow Control Div.)
411 N. Lexington Ave.
Pittsburgh, PA 15208
412-247-3000

Smith Meter Div.
(Geosource, Inc.)
Dept. T
P.O. Box 10428
Erie, PA 16514
814-899-0661

Moisture Detectors

Beckman Instruments, Inc.
2500-T Harbor Blvd.
Fullerton, CA 92634
714-871-4848

E.I. du Pont de Nemours & Co., Inc.
Analytical Instruments Div.
3411 Silverside Rd.
Concord Plaza
Quillen Building
Wilmington, DE 19810
302-772-5500

Teledyne Analytical Instruments
16830 Chestnut Dr.
City of Industry, CA 91748
818-961-9221

Pumps *(Canned)*

Crane Company
(Chempump Div.)
175 Titus Ave.
Warrington, PA 18976
215-343-6000

Pumps *(Centrifugal)*

Allis-Chalmers Pump, Inc.
P.O. Box 512
Milwaukee, WI 53201
414-475-2000

The Duriron Company, Inc.
N. Findlay & Thomas Sts.
Dayton, OH 45401
513-226-4000

Goulds Pumps, Inc.
240 Fall St.
Seneca Falls, NY 13148
315-568-2811

Ingersoll-Rand
(Pump Group)
1200 West Belt Drive North
Houston, TX 77043
713-467-2221

Pumps *(Magnetic Drive)*

Bullen Pump & Equipment, Inc.
P.O. Box 770845
Houston, TX 77215
713-493-4840

The Kontro Co., Inc.
450 W. River St.
Orange, MA 01360
617-544-2536

Pumps
(Positive Displacement)

Blackmer Pump
(Div. Dover Corp.)
1809 Century Ave., S.W.
Grand Rapids, MI 49509
616-241-1611

Nichols/Zenith
(Div. of Parker Hannifin Corp.)
P.O. Box 71-T
Waltham, MA 02254
617-894-0650

Roper Pump Co.
P.O. Box 269
Commerce, GA 30529
404-335-5551

Viking Pump — Houdaille, Inc.
George & Wyth Sts.
Cedar Falls, IA 50613
319-266-1741

Waukesha Division
(Abex Corp.)
5510 Lincoln Ave.
Waukesha, WI 53186
414-542-0741

Refrigeration Units

Carrier Corp.
P.O. Box 4808
Syracuse, NY 13221
315-432-6000

Dunham-Bush, Inc.
178 South St.
West Hartford, CT 06110
203-249-8671

Ronningen-Petter
(Div. Dover Corp.)
P.O. Box 188T
Portage, MI 49081
616-323-1313

Vilter Mfg. Corp.
2217-T S. First St.
Milwaukee, WI 53207
414-744-0111

Safety Equipment

American Optical Corp.
(Safety Products Div.)
14 Mechanic St.
Southbridge, MA 01550
617-765-9711

Bausch & Lomb Inc.
P.O. Box 450
Rochester, NY 14692
716-338-6000

E. D. Bullard Co.
2682 Bridgeway
Sausalito, CA 94965
415-332-0410

Mine Safety Appliances Co.
P.O. Box 426
Pittsburgh, PA 15230
1-800-672-2222

Strainers

Cuno, Inc.
(Commercial Shearing, Inc.)
402 Research Pky.
Meriden, CT 06450
203-237-5541 or 1-800-243-6894

Dover Corp., OPW Div.
277-T Park Ave.
New York, NY 10172
212-826-7160

Swivel Joints

FMC Corporation
Fluid Control Operation
1803 Gears Rd.
Houston, TX 77067
713-591-4000

LTV Energy Products Co.
P.O. Box 461388
Garland, TX
214-276-5151

Synthetics

E.I. du Pont de Nemours & Co., Inc.
1007-T Market St.
Wilmington, DE 19898
302-774-2421

Tanks

Buffalo Tank Corp.
P.O. Box 2755-T
Baltimore, MD 21225
1-800-368-2105

Tape

E.I. du Pont de Nemours & Co., Inc.
1007 Market St.
Wilmington, DE 19898
302-774-2421

Thermometers

(Note: Most manufacturers of thermometers also supply thermowells.)

Palmer Instruments, Inc.
3131 Wasson Rd.
Cincinnati, OH 45209
513-871-7800

Princo Instruments, Inc.
1020-T Industrial Highway
Southampton, PA 18966
215-355-1500

Valves

Crane Co.
(Valve Div.)
800 E. Third Ave.
King of Prussia, PA 19406
215-962-0366

Jamesbury Corp.
640 Lincoln St.
Worcester, MA 01605
1-800-243-8160

KTM Industries Inc.
16610-T Barker Springs Rd.
Houston, TX 77084
713-492-8800

The Lunkenheimer Co.
Beekman St. at Waverly Ave.
Cincinnati, OH 45214
513-921-3400

Rockwell International Corp.
401 N. Lexington Ave.
Pittsburgh, PA 15208
412-247-3000

Valves
(Control)

Fisher Controls International, Inc.
205-T S. Center St.
Marshalltown, IA 50158
515-754-3011

Masoneilan Div.
(McGraw-Edison Co.)
P.0. Box 4020
Woodlands, TX 77387
713-367-5741

Valves
(Relief/Vents)

Crosby Valve & Gage Co.
43 Kendrick St.
Wrentham, MA 02093
617-384-3121

Emerson Electric Co.
8000 W. Florissant Ave.
St. Louis, MO 63136
314-553-2000

Oceco Division
(Pettibone Corp.)
4700-T W. Division St.
Chicago, IL 60651
312-772-9300

The Protectoseal Co.
227 Foster Ave.
Bensenville, IL 60106
312-595-0800

Sentry Tank Accessories, Inc.
3800 N. Carnation St.
Franklin, IL 60131
312-671-1500

Vapor Detectors

GMD Systems Inc.
Old Route 519
Hendersonville, PA 15339
412-746-3600

MDA Scientific, Inc.
405 Barclay Blvd.
Lincolnshire, IL 60069
1-800-323-2000
(Illinois: 312-634-2800)

National Draeger, Inc.
P.0. Box 120
Pittsburgh, PA 15230
412-787-8383

APPENDIX B

Equipment Manufacturers and Suppliers: Respiratory Protective Equipment

The following list of manufacturers and suppliers[1] of NIOSH-approved respiratory protective equipment was obtained from the National Institute for Occupational Safety and Health, Morgantown, WV 26505. Questions about the specifications or suitability of any of the products offered by these firms should be addressed to the firm in question. The Dow Chemical Company neither endorses the products offered nor guarantees their performance. Reference to a company or product by name does not imply approval or recommendation by Dow of any product to the exclusion of others that may be suitable for the intended purpose.

[1]The names, addresses, ZIP codes, and telephone numbers listed here are accurate as of the date of publication. For current information, consult *Thomas Register, Standard & Poor's,* or the *Dun & Bradstreet Reference Book of Manufacturers.*

Ace Enterprises
820-T N.W. 144th St.
Miami, FL 33168
305-685-8784

American Optical Corp.
Safety Products Division
14 Mechanic St.
Southbridge, MA 01550
617-765-9711

Andersen Manufacturing Co., Inc.
P.O. Box 318
Furlong, PA 18925
215-794-8121

Binks Manufacturing Co.
9201 W. Belmont Ave.
Franklin Park, IL 60131
312-671-3000

BioMarine Industries, Inc.
45 Great Valley Center
Malvern, PA 19355
215-647-7200

Bowen Tools, Inc.
2400-T Crockett St.
P.O. Box 3186
Houston, TX 77253
713-869-6711

Browning Ferris Industries, Inc.
14701-T St. Mary's Lane
P.O. Box 3151
Houston, TX 77253
713-870-8100

E. D. Bullard Co.
2682 Bridgeway
Sausalito, CA 94965
415-332-0410

Cesco Safety Products
(Parmelee Industries, Inc.)
1535 Walnut St.
P.O. Box 1237
Kansas City, MO 64141
816-842-8500

Clemco Industries
1657 Rollins Rd.
Burlingame, CA 94010
415-570-6000

Clemtex, Inc.
248 McCarthy Dr.
Houston, TX 77029
713-672-8251

Defense Apparel
247-T Addison Rd.
Windsor, CT 06095
203-522-1957

The DeVilbiss Company
P.O. Box 913-T
Toledo, OH 43692
1-800-628-1200, ext. 735

A. E. Draegerwerk
2400 Lubeck 1
Postfach 1339
Moislinger Allee 53/55
West Germany

Eastern Safety Equipment Co., Inc.
59-20-T 56th Ave.
Maspeth, NY 11378
718-894-7900

Empire Abrasive Equipment Corp.
2101 W. Cabot Blvd.
Langhorne, PA 19047
215-752-8800

Encon Manufacturing Co.
P.O. Box 3826-TR
Houston, TX 77253
713-462-4723, Ext. 127

The Fibre Metal Products Co.
Brinton Lake Rd. & Rte. 1
Concordville, PA 19331
215-459-5300

Glendale Optical Co., Inc.
130 Crossways Park Dr.
Woodbury, NY 11797
516-921-5800

Globe Safety Equipment, Inc.
125 Sunrise Place
P.O. Box 7248
Dayton, OH 45407
513-224-7468

HSC Corp.
107 E. Alexander St.
Buchanan, MI 49107
616-695-9663

Kelco Sales & Engineering Co.
Front St. & Paddison Ave.
Norwalk, CA 90650
213-868-9861

Key Houston, Inc.
13911 Atlantic Blvd.
Jacksonville, FL 32225
904-241-4191

Lear Siegler, Inc.
714 N. Brookhurst St.
Anaheim, CA 92803
714-774-1010

Mine Safety Appliances Co.
P.O. Box 426
Pittsburgh, PA 15230
1-800-672-2222

Mohawk Industrial Supply Co.
P.O. Box 945
Manchester, CT 06040
203-643-5107

National Draeger, Inc.
P.O. Box 120
Pittsburgh, PA 15230
412-787-8383

Norton Consumer Products
(A Div. of Siebe North, Inc.)
P.O. Box 7500
16624 Edwards Road
Cerritos, CA 90701
213-926-0545 or 1-800-421-3841

Pauli & Griffin Co.
907 Cotting Lane
Vacaville, CA 96588
707-447-7000

Pulmosan Safety Equipment Corp.
30-48-T Linden Place
Flushing, NY 11354
718-939-3200

Robertshaw Controls Co.
P.O. Box 26544
Richmond, VA 23261
804-281-0700

Safe-Tex Manufacturing Co.
15 Brandon
Toronto, Ontario, Canada
416-534-4223

Safety and Supply Co.
5510 East Marginal Way
South Seattle, WA 98134
206-762-8500

Schmidt Manufacturing, Inc.
P.O. Box 37
11927 S. Highway 6
Houston, TX 77053
713-434-0581

Scott Aviation
(A Div. of A-T-O Inc.)
2225 Erie St.
Lancaster, NY 14086
716-683-5100

Sellstrom Mfg. Co.
P.O. Box 355
Palatine, IL 60078
312-358-2000

Siebe Gorman Holdings Ltd.
Neptune Works Davis Rd.
Chessington Surrey, England KT9

Standard Safety Equipment Co.
P.O. Box 188
Palatine, IL 60078
312-359-6000

Stewart-Warner Corp.
1826 W. Diversey Pkwy.
Chicago, IL 60614
312-883-6000

3M Company
3M Center
St. Paul, MN 55144
612-733-1110

Titan Abrasive Systems, Inc.
P.O. Box 318-T
Furlong, PA 18925
215-794-5661

United States Safety Service Co.
1535 Walnut St.
P.O. Box 1237
Kansas City, MO 64141
816-842-8500

Willson Safety Products
Div. of WGM Safety Corp.
P.O. Box 622, Dept. T
Reading, PA 19603
215-376-6161

APPENDIX C

References

Literature published by the following organizations:

American Conference of Governmental Industrial Hygienists
6500 Glenway Avenue, Building D-7
Cincinnati, OH 45211
513-661-7881

International Isocyanate Institute, Inc.
119 Cherry Hill Road
Parsippany, NJ 07054
201-263-7517

National Institute for Occupational Safety and Health
944 Chestnut Ridge Road
Morgantown, WV 26505
304-291-4126

Occupational Safety and Health Administration
Department of Labor
200 Constitution Avenue N.W.
Washington, DC 20210
202-523-9361]

The Society of the Plastics Industry, Inc.
350 Lexington Ave.
New York, NY 10017
212-573-9400

Product Stewardship

The Dow Chemical Company has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our Product Stewardship philosophy, by which we assess the health and environmental information on our products and then take appropriate steps to protect employee and public health and the environment. Our Product Stewardship program rests with each and every individual involved with Dow products — from the initial concept and research to the manufacture, sale, distribution, use, and disposal of each product.

Customer Notice

The Dow Chemical Company strongly encourages its customers to review both their manufacturing processes and their application of Dow products from the standpoint of human health and environmental quality. To help ensure that Dow products are not used in ways for which they were not intended or tested, Dow personnel are prepared to assist customers in dealing with both ecological and product safety considerations. Your Dow representative can arrange the proper contacts.

CHEMTREC

FOR CHEMICAL EMERGENCY
Spill, Leak, Fire, Exposure, or Accident
CALL CHEMTREC
DAY OR NIGHT

***800-424-9300**
Toll-free in the continental U.S.
*Add long-distance access number if required

483-7616 in District of Columbia

For calls originating outside the
Continental U.S.: 202-483-7616
— Washington, DC, Collect
ALL CALLS ARE RECORDED

CMA

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E/R
DISTRIBUTION EMERGENCY
RESPONSE SYSTEM

DISTRIBUTION EMERGENCIES
AND CHEMICAL EMERGENCIES
INVOLVING
EXPOSURES, LEAKS OR SPILLS
Call: 517-636-4400 (Midland, MI)
409-238-2112 (Freeport, TX)

DOW CHEMICAL U.S.A.

An Operating Unit of The Dow Chemical Company
PLASTICS GROUP
URETHANES DEPARTMENT
2040 WILLARD H. DOW CENTER
MIDLAND, MICHIGAN 48674

Major Urethanes Sales Offices of Dow Chemical U.S.A.

ATLANTA ..... Suite 2005, 20 Perimeter Center East, Atlanta, GA 30346 • 404-394-4141
(*for*: AL, AR, FL, GA, KY (western), MS, NC, TN, VA)

CHICAGO .... Suite 800, 10 Gould Center, 2840 Golf Road, Rolling Meadows, IL 60008 • 312-228-2700
(*for*: IL, IN, MN, MO (eastern), ND, SD, WI)

DALTON ..... 2864 North Dug Gap Road, Dalton, GA 30720 • 404-277-1133
(*for*: all states — carpet business only)

DETROIT ..... Suiter 415, Travelers Tower, 26555 Evergreen Road, Southfield, MI 48076 • 313-358-1300
(*for*: KY (eastern), MI, OH, PA (western), WV)

HOUSTON ..... P.O. Box 4269, 400 West Belt South, Houston, TX 77210 • 713-978-3700
(*for*: CO, IA, KS, LA, MO (western), NE, MN, OK, TX, WY)

LOS ANGELES ..... 17870 Castleton St., P.O. Box 881, City of Industry, CA 91747 • 818-810-8050
(*for*: AK, AZ, CA, HI, ID, MT, NV, OR, UT, WA)

PHILADELPHIA ..... 505 S. Lenola Road, Moorestown, NJ 08057 • 609-234-0400
(*for*: CT, DE, MA, MD, ME, NH, NJ, NY, PA (eastern), RI, VT)

For product and technical literature

Contact: INQUIRY & DISTRIBUTION SERVICES
Saginaw Road Bldg., The Dow Chemical Company, Midland, MI 48640 • **1-800-258-CHEM** 8 a.m. - 5 p.m. E.S.T.

For information on products, applications, prices, ordering, billing, and delivery

Contact: URETHANES CUSTOMER SERVICE CENTER
400 West Belt South, P.O. Box 4265, Houston, TX 77210 • **1-800-258-2333** 8 a.m. - 6 p.m. E.S.T.

Printed in U.S.A.

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Form No. 109-561-288 SMG
CC076020

4.05 Particle Size -- If the listed substance exists in particulate form during any of the following activities, indicate for each applicable physical state the size and the percentage distribution of the listed substance by activity. Do not include particles ≥10 microns in diameter. Measure the physical state and particle sizes for importing and processing activities at the time you import or begin to process the listed substance. Measure the physical state and particle sizes for manufacturing storage, disposal and transport activities using the final state of the product.

CBI

[ ]

Not applicable to TDI

Physical State		Manufacture	Import	Process	Store	Dispose	Transport
Dust	<1 micron						
	1 to <5 microns						
	5 to <10 microns						
Powder	<1 micron						
	1 to <5 microns						
	5 to <10 microns						
Fiber	<1 micron						
	1 to <5 microns						
	5 to <10 microns						
Aerosol	<1 micron						
	1 to <5 microns						
	5 to <10 microns						

[ ] Mark (X) this box if you attach a continuation sheet.

SECTION 5 ENVIRONMENTAL FATE

PART A RATE CONSTANTS AND TRANSFORMATION PRODUCTS

5.01 Indicate the rate constants for the following transformation processes.

a. Photolysis: Unknown

Absorption spectrum coefficient (peak) .... _____ (1/M cm) at _____ nm

Reaction quantum yield, ϕ ..... _____ at _____ nm

Direct photolysis rate constant, k_p, at ... _____ 1/hr _____ latitude

b. Oxidation constants at 25°C: Unknown

For $^1O_2$ (singlet oxygen), k_{ox} ..... _____ 1/M hr

For RO_2 (peroxy radical), k_{ox} ..... _____ 1/M hr

c. Five-day biochemical oxygen demand, BOD_5 ... _____ mg/l

d. Biotransformation rate constant: Unknown

For bacterial transformation in water, k_b... _____ 1/hr

Specify culture ..... _____

e. Hydrolysis rate constants: Unknown

For base-promoted process, k_B ..... _____ 1/M hr

For acid-promoted process, k_A ..... _____ 1/M hr

For neutral process, k_N ..... _____ 1/hr

f. Chemical reduction rate (specify conditions) Unknown

_____

g. Other (such as spontaneous degradation) ... Unknown

_____

[ ] Mark (X) this box if you attach a continuation sheet.

PART B PARTITION COEFFICIENTS

5.02 a. Specify the half-life of the listed substance in the following media.

Media	Half-life (specify units)
Groundwater	Unknown
Atmosphere	
Surface water	
Soil	

b. Identify the listed substance's known transformation products that have a half-life greater than 24 hours.

CAS No.	Name	Half-life (specify units)		Media
Unknown			in	
			in	
			in	
			in	

5.03 Specify the octanol-water partition coefficient, K_{ow} ... Unknown at 25°C

Method of calculation or determination .....

5.04 Specify the soil-water partition coefficient, K_d ..... Unknown at 25°C

Soil type .....

5.05 Specify the organic carbon-water partition coefficient, K_{oc} ..... Unknown at 25°C

5.06 Specify the Henry's Law Constant, H ..... Unknown atm-m^3/mole

[ ] Mark (X) this box if you attach a continuation sheet.

5.07 List the bioconcentration factor (BCF) of the listed substance, the species for which it was determined, and the type of test used in deriving the BCF.

Bioconcentration Factor	Species	Test[1]
Unknown		

[1]Use the following codes to designate the type of test:

F = Flowthrough
S = Static

[ ] Mark (X) this box if you attach a continuation sheet.

6.04 For each market listed below, state the quantity sold and the total sales value of
CBI the listed substance sold or transferred in bulk during the reporting year.

[ ]

Market	Quantity Sold or Transferred (kg/yr)	Total Sales Value ($/yr)
Retail sales	N/R for TDI	
Distribution -- Wholesalers		
Distribution -- Retailers		
Intra-company transfer		
Repackagers		
Mixture producers		
Article producers		
Other chemical manufacturers or processors		
Exporters		
Other (specify)		

6.05 Substitutes -- List all known commercially feasible substitutes that you know exist for the listed substance and state the cost of each substitute. A commercially feasible substitute is one which is economically and technologically feasible to use
CBI in your current operation, and which results in a final product with comparable performance in its end uses.

[ ]

Substitute	Cost ($/kg)
N/A	

[ ] Mark (X) this box if you attach a continuation sheet.

SECTION 7 MANUFACTURING AND PROCESSING INFORMATION

General Instructions:

For questions 7.04-7.06, provide a separate response for each process block flow diagram provided in questions 7.01, 7.02, and 7.03. Identify the process type from which the information is extracted.

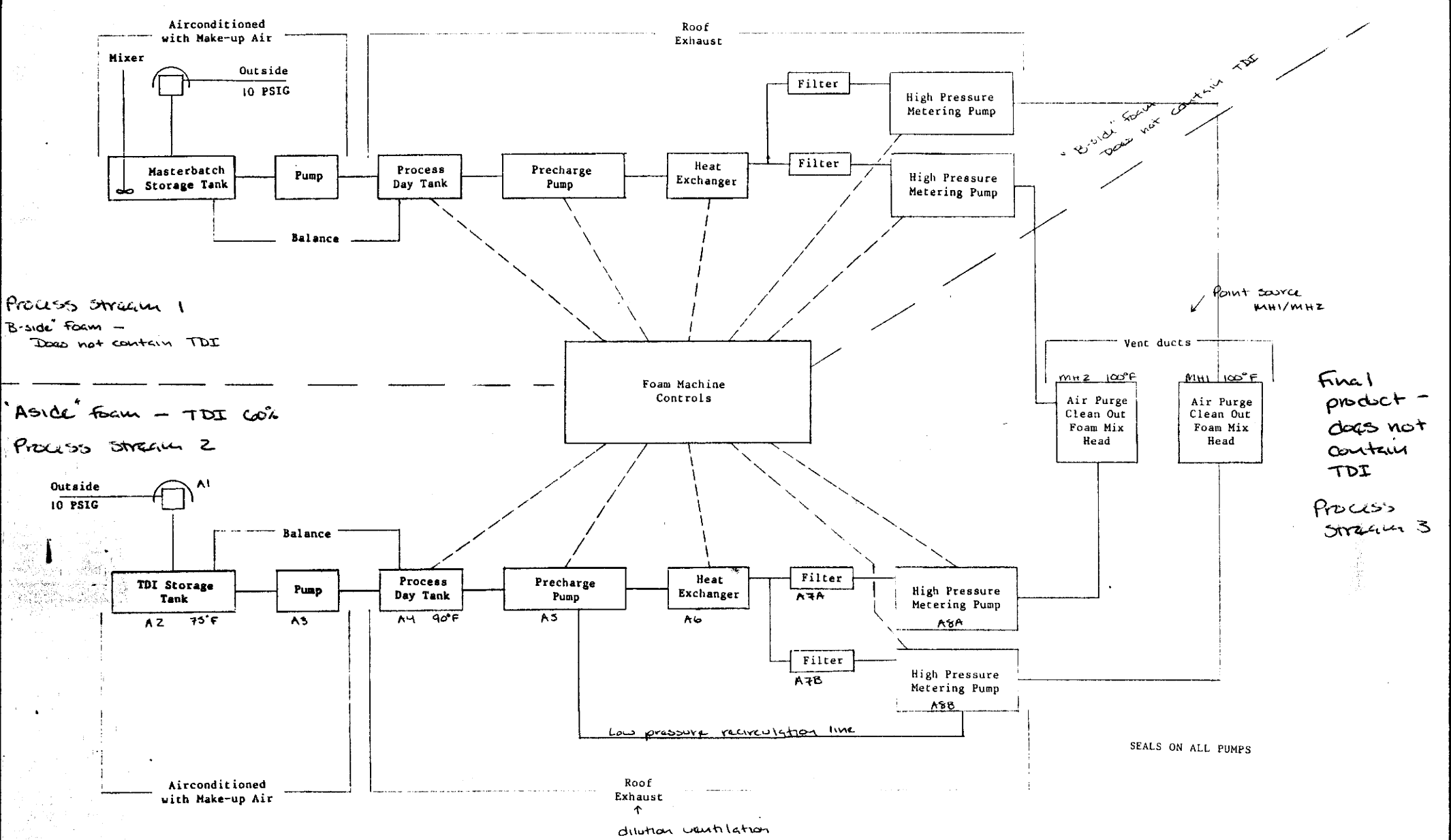
PART A MANUFACTURING AND PROCESSING PROCESS TYPE DESCRIPTION

7.01 In accordance with the instructions, provide a process block flow diagram showing the major (greatest volume) process type involving the listed substance.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

[X] Mark (X) this box if you attach a continuation sheet.



7/6/89
JS/CLK

Attachment 4

7.03 In accordance with the instructions, provide a process block flow diagram showing all process emission streams and emission points that contain the listed substance and which, if combined, would total at least 90 percent of all facility emissions if not treated before emission into the environment. If all such emissions are released from one process type, provide a process block flow diagram using the instructions for question 7.01. If all such emissions are released from more than one process type, provide a process block flow diagram showing each process type as a separate block.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

See Attachment 4

[X] Mark (X) this box if you attach a continuation sheet.

7.04 Describe the typical equipment types for each unit operation identified in your process block flow diagram(s). If a process block flow diagram is provided for more than one process type, photocopy this question and complete it separately for each process type.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Unit Operation ID Number	Typical Equipment Type	Operating Temperature Range (°C)	Operating Pressure Range (mm Hg)	Vessel Composition
A2	Storage tank	15-25	470	Steel
A4	Day tank	15-25	470	Steel
A5	Precharge pump		3800	Steel
A7	Filters		470	Steel
A8	Metering pump			Steel
MH1/2	Mix heads	35-40	73,000	Steel

[ ] Mark (X) this box if you attach a continuation sheet.

7.05 Describe each process stream identified in your process block flow diagram(s). If a process block flow diagram is provided for more than one process type, photocopy this question and complete it separately for each process type.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Process Stream ID Code	Process Stream Description	Physical State[1]	Stream Flow (kg/yr)
2	TDI - 60%	OL	63,000
1	Does not contain TDI	OL	80,000
3	Final product - does not contain TDI	SO	135,000*

[1]Use the following codes to designate the physical state for each process stream:

GC = Gas (condensible at ambient temperature and pressure)
GU = Gas (uncondensible at ambient temperature and pressure)
SO = Solid
SY = Sludge or slurry
AL = Aqueous liquid
OL = Organic liquid
IL = Immiscible liquid (specify phases, e.g., 90% water, 10% toluene)

* Raw materials do not balance due to freon emissions.

[ ] Mark (X) this box if you attach a continuation sheet.

7.06 Characterize each process stream identified in your process block flow diagram(s). If a process block flow diagram is provided for more than one process type, photocopy this question and complete it separately for each process type. (Refer to the CBI instructions for further explanation and an example.)

[ ] Process type ..... Polyurethane foam insulation manufacturing

a. Process Stream ID Code	b. Known Compounds[1]	c. Concentrations[2,3] (% or ppm)	d. Other Expected Compounds	e. Estimated Concentrations (% or ppm)
A side	TDI	60	Unknown	
	TDI prepolymers	40		
B side	polyol	70	Unknown	
	R-11	26		
	Amine catalyst	<1		
	Tin catalyst	<1		
	Silicon surfactant	<1		
	Water	<1		

7.06 continued below

[ ] Mark (X) this box if you attach a continuation sheet.

7.06 (continued)

[1]For each additive package introduced into a process stream, specify the compounds that are present in each additive package, and the concentration of each component. Assign an additive package number to each additive package and list this number in column b. (Refer to the instructions for further explanation and an example. Refer to the glossary for the definition of additive package.)

Additive Package Number	Components of Additive Package	Concentrations (% or ppm)
1	N/A	
2		
3		
4		
5		

[2]Use the following codes to designate how the concentration was determined:

A = Analytical result
E = Engineering judgement/calculation

[3]Use the following codes to designate how the concentration was measured:

V = Volume
W = Weight

[ ] Mark (X) this box if you attach a continuation sheet.

SECTION 8 RESIDUAL TREATMENT GENERATION, CHARACTERIZATION, TRANSPORTATION, AND MANAGEMENT

General Instructions:

For questions 8.04-8.06, provide a separate response for each residual treatment block flow diagram provided in question 8.01, 8.02 or 8.03. Identify the process type from which the information is extracted.

For questions 8.05-8.33, the Stream Identification Codes are those process streams listed in either the Section 7 or Section 8 block flow diagrams which contain residuals for each applicable waste management method.

For questions 8.07-8.33, if residuals are combined before they are handled, list those Stream Identification Codes on the same line.

Questions 8.09-8.33 refer to the waste management activities involving the residuals identified in either the Section 7 or Section 8 block flow diagrams. Not all Stream Identification Codes used in the sample answers (e.g., for the incinerator questions) have corresponding process streams identified in the block flow diagram(s). These Stream Identification codes are for illustrative purposes only.

For questions 8.11-8.33, if you have provided the information requested on one of the EPA Office of Solid Waste surveys listed below within the three years prior to your reporting year, you may submit a copy or reasonable facsimile in lieu of answering those questions which the survey addresses. The applicable surveys are: (1) Hazardous Waste Treatment, Storage, Disposal, and Recycling Survey; (2) Hazardous Waste Generator Survey; or (3) Subtitle D Industrial Facility Mail Survey.

[ ] Mark (X) this box if you attach a continuation sheet.

PART A RESIDUAL TREATMENT PROCESS DESCRIPTION

8.01 In accordance with the instructions, provide a residual treatment block flow diagram which describes the treatment process used for residuals identified in question 7.01.

CBI

[ ] Process type ..... Not applicable - no on site residual treatment

[ ] Mark (X) this box if you attach a continuation sheet.

PART B RESIDUAL GENERATION AND CHARACTERIZATION

8.05 Characterize each process stream identified in your residual treatment block flow diagram(s). If a residual treatment block flow diagram is provided for more than one process type, photocopy this question and complete it separately for each process
CBI type. (Refer to the instructions for further explanation and an example.)

[ ] Process type ..... Not applicable - no on site residual treatment

a. Stream ID Code	b. Type of Hazardous Waste[1]	c. Physical State of Residual[2]	d. Known Compounds[3]	e. Concentrations (% or ppm)[4,5,6]	f. Other Expected Compounds	g. Estimated Concentrations (% or ppm)

8.05 continued below

[ ] Mark (X) this box if you attach a continuation sheet.

8.05 (continued)

[1]Use the following codes to designate the type of hazardous waste:

I = Ignitable
C = Corrosive
R = Reactive
E = EP toxic
T = Toxic
H = Acutely hazardous

[2]Use the following codes to designate the physical state of the residual:

GC = Gas (condensible at ambient temperature and pressure)
GU = Gas (uncondensible at ambient temperature and pressure)
SO = Solid
SY = Sludge or slurry
AL = Aqueous liquid
OL = Organic liquid
IL = Immiscible liquid (specify phases, e.g., 90% water, 10% toluene)

8.05 continued below

[ ] Mark (X) this box if you attach a continuation sheet.

8.05 (continued)

[3]For each additive package introduced into a process stream, specify the compounds that are present in each additive package, and the concentration of each component. Assign an additive package number to each additive package and list this number in column d. (Refer to the instructions for further explanation and an example. Refer to the glossary for the definition of additive package.)

Additive Package Number	Components of Additive Package	Concentrations (% or ppm)
1		
2		
3		
4		
5		

[4]Use the following codes to designate how the concentration was determined:

A = Analytical result
E = Engineering judgement/calculation

8.05 continued below

[ ] Mark (X) this box if you attach a continuation sheet.

8.05 (continued)

[5]Use the following codes to designate how the concentration was measured:

V = Volume
W = Weight

[6]Specify the analytical test methods used and their detection limits in the table below. Assign a code to each test method used and list those codes in column e.

Code	Method	Detection Limit (± ug/l)
1		
2		
3		
4		
5		
6		

[ ] Mark (X) this box if you attach a continuation sheet.

8.06 Characterize each process stream identified in your residual treatment block flow diagram(s). If a residual treatment block flow diagram is provided for more than one process type, photocopy this question and complete it separately for each process type. (Refer to the instructions for further explanation and an example.)

CBI

[ ] Process type ..... Not applicable - no on site residual treatment

a. Stream ID Code	b. Waste Description Code[1]	c. Management Method Code[2]	d. Residual Quantities (kg/yr)	e. Management of Residual (%) On-Site	e. Management of Residual (%) Off-Site	f. Costs for Off-Site Management (per kg)	g. Changes in Management Methods

[1]Use the codes provided in Exhibit 8-1 to designate the waste descriptions

[2]Use the codes provided in Exhibit 8-2 to designate the management methods

[ ] Mark (X) this box if you attach a continuation sheet.

EXHIBIT 8-1.
(Refers to question 8.06(b))

WASTE DESCRIPTION CODES

These waste description codes were developed specifically for this survey to supplement the descriptions listed with the RCRA and other waste codes. (These waste description codes are not regulatory definitions.)

WASTE DESCRIPTION CODES FOR HAZARDOUS WASTE DESCRIBED BY A SINGLE RCRA F, K, P, OR U WASTE CODE

A01 Spent solvent (F001-F005, K086)
A02 Other organic liquid (F001-F005, K086)
A03 Still bottom (F001-F005, K086)
A04 Other organic sludge (F001-F005, K086)
A05 Wastewater or aqueous mixture
A06 Contaminated soil or cleanup residue
A07 Other F or K waste, exactly as described*
A08 Concentrated off-spec or discarded product
A09 Empty containers
A10 Incinerator ash
A11 Solidified treatment residue
A12 Other treatment residue (specify in "Facility Notes")
A13 Other untreated waste (specify in "Facility Notes")

*"Exactly as described" means that the waste matches the description of the RCRA waste code.

INORGANIC LIQUIDS—Waste that is primarily inorganic and highly fluid (e.g., aqueous), with low suspended inorganic solids and low organic content

B01 Aqueous waste with low solvents
B02 Aqueous waste with low other toxic organics
B03 Spent acid with metals
B04 Spent acid without metals
B05 Acidic aqueous waste
B06 Caustic solution with metals but no cyanides
B07 Caustic solution with metals and cyanides
B08 Caustic solution with cyanides but no metals
B09 Spent caustic
B10 Caustic aqueous waste
B11 Aqueous waste with reactive sulfides
B12 Aqueous waste with other reactives (e.g., explosives)
B13 Other aqueous waste with high dissolved solids
B14 Other aqueous waste with low dissolved solids
B15 Scrubber water
B16 Leachate
B17 Waste liquid mercury
B18 Other inorganic liquid (specify in "Facility Notes")

INORGANIC SLUDGES—Waste that is primarily inorganic, with moderate-to-high water content and low organic content; pumpable.

B19 Lime sludge without metals
B20 Lime sludge with metals/metal hydroxide sludge
B21 Wastewater treatment sludge with toxic organics
B22 Other wastewater treatment sludge
B23 Untreated plating sludge without cyanides
B24 Untreated plating sludge with cyanides
B25 Other sludge with cyanides
B26 Sludge with reactive sulfides
B27 Sludge with other reactives
B28 Degreasing sludge with metal scale or filings
B29 Air pollution control device sludge (e.g., fly ash, wet scrubber sludge)
B30 Sediment or lagoon dragout contaminated with organics
B31 Sediment or lagoon dragout contaminated with inorganics only
B32 Drilling mud
B33 Asbestos slurry or sludge
B34 Chloride or other brine sludge
B35 Other inorganic sludge (specify in "Facility Notes")

INORGANIC SOLIDS—Waste that is primarily inorganic and solid, with low organic content and low-to-moderate water content; not pumpable.

B36 Soil contaminated with organics
B37 Soil contaminated with inorganics only
B38 Ash, slag, or other residue from incineration of wastes
B39 Other "dry" ash, slag, or thermal residue
B40 "Dry" lime or metal hydroxide solids chemically "fixed"
B41 "Dry" lime or metal hydroxide solids not "fixed"
B42 Metal scale, filings, or scrap
B43 Empty or crushed metal drums or containers
B44 Batteries or battery parts, casings, cores
B45 Spent solid filters or adsorbents
B46 Asbestos solids and debris
B47 Metal-cyanide salts/chemicals
B48 Reactive cyanide salts/chemicals
B49 Reactive sulfide salts/chemicals
B50 Other reactive salts/chemicals
B51 Other metal salts/chemicals
B52 Other waste inorganic chemicals
B53 Lab packs of old chemicals only
B54 Lab packs of debris only
B55 Mixed lab packs
B56 Other inorganic solids (specify in "Facility Notes")

INORGANIC GASES—Waste that is primarily inorganic with a low organic content and is a gas at atmospheric pressure.

B57 Inorganic gases

ORGANIC LIQUIDS—Waste that is primarily organic and is highly fluid, with low inorganic solids content and low-to-moderate water content.

B58 Concentrated solvent-water solution
B59 Halogenated (e.g., chlorinated) solvent
B60 Nonhalogenated solvent
B61 Halogenated/nonhalogenated solvent mixture
B62 Oil-water emulsion or mixture
B63 Waste oil
B64 Concentrated aqueous solution of other organics
B65 Concentrated phenolics
B66 Organic paint, ink, lacquer, or varnish
B67 Adhesives or expoxies
B68 Paint thinner or petroleum distillates
B69 Reactive or polymerizable organic liquid
B70 Other organic liquid (specify in "Facility Notes")

ORGANIC SLUDGES—Waste that is primarily organic, with low-to-moderate inorganic solids content and water content; pumpable.

B71 Still bottoms of halogenated (e.g., chlorinated) solvents or other organic liquids
B72 Still bottoms of nonhalogenated solvents or other organic liquids
B73 Oily sludge
B74 Organic paint or ink sludge
B75 Reactive or polymerizable organics
B76 Resins, tars, or tarry sludge
B77 Biological treatment sludge
B78 Sewage or other untreated biological sludge
B79 Other organic sludge (specify in "Facility Notes")

ORGANIC SOLIDS—Waste that is primarily organic and solid, with low-to-moderate inorganic content and water content; not pumpable.

B80 Halogenated pesticide solid
B81 Nonhalogenated pesticide solid
B82 Solid resins or polymerized organics
B83 Spent carbon
B84 Reactive organic solid
B85 Empty fiber or plastic containers
B86 Lab packs of old chemicals only
B87 Lab packs of debris only
B88 Mixed lab packs
B89 Other halogenated organic solid
B90 Other nonhalogenated organic solid

ORGANIC GASES—Waste that is primarily organic with low-to-moderate inorganic content and is a gas at atmospheric pressure.

B91 Organic gases

EXHIBIT 8-2.
(Refers to question 8.06(c))

MANAGEMENT METHODS

M1 = Discharge to publicly owned wastewater treatment works
M2 = Discharge to surface water under NPDES
M3 = Discharge to off-site, privately owned wastewater treatment works
M4 = Scrubber: a) caustic; b) water; c) other
M5 = Vent to: a) atmosphere; b) flare; c) other (specify)_____
M6 = Other (specify)_____

TREATMENT AND RECYCLING

Incineration/thermal treatment
1I Liquid injection
2I Rotary or rocking kiln
3I Rotary kiln with a liquid injection unit
4I Two stage
5I Fixed hearth
6I Multiple hearth
7I Fluidized bed
8I Infrared
9I Fume/vapor
10I Pyrolytic destructor
11I Other incineration/thermal treatment

Reuse as fuel
1RF Cement kiln
2RF Aggregate kiln
3RF Asphalt kiln
4RF Other kiln
5RF Blast furnace
6RF Sulfur recovery furnace
7RF Smelting, melting, or refining furnace
8RF Coke oven
9RF Other industrial furnace
10RF Industrial boiler
11RF Utility boiler
12RF Process heater
13RF Other reuse as fuel unit

Fuel Blending
1FB Fuel blending

Solidification
1S Cement or cement/silicate processes
2S Pozzolanic processes
3S Asphaltic processes
4S Thermoplastic techniques
5S Organic polymer techniques
6S Jacketing (macro-encapsulation)
7S Other solidification

Recovery of solvents and liquid organics for reuse
1SR Fractionation
2SR Batch still distillation
3SR Solvent extraction
4SR Thin-film evaporation
5SR Filtration
6SR Phase separation
7SR Dessication
8SR Other solvent recovery

Recovery of metals
1MR Activated carbon (for metals recovery)
2MR Electrodialysis (for metals recovery)
3MR Electrolytic metal recovery
4MR Ion exchange (for metals recovery)
5MR Reverse osmosis (for metals recovery)
6MR Solvent extraction (for metals recovery)
7MR Ultrafiltration (for metals recovery)
8MR Other metals recovery

Wastewater Treatment
After each wastewater treatment type listed below (1WT - 66WT) specify a) tank; or b) surface impoundment (i.e.. 63WTa)

Equalization
1WT Equalization

Cyanide oxidation
2WT Alkaline chlorination
3WT Ozone
4WT Electrochemical
5WT Other cyanide oxidation

General oxidation (including disinfection)
6WT Chlorination
7WT Ozonation
8WT UV radiation
9WT Other general oxidation

Chemical precipitation[1]
10WT Lime
11WT Sodium hydroxide
12WT Soda ash
13WT Sulfide
14WT Other chemical precipitation

Chromium reduction
15WT Sodium bisulfite
16WT Sulfur dioxide

EXHIBIT 8-2. (continued)

MANAGEMENT METHODS

17WT Ferrous sulfate
18WT Other chromium reduction

Complexed metals treatment (other than chemical precipitation by pH adjustment)
19WT Complexed metals treatment[1]

Emulsion breaking
20WT Thermal
21WT Chemical
22WT Other emulsion breaking

Adsorption
23WT Carbon adsorption
24WT Ion exchange
25WT Resin adsorption
26WT Other adsorption

Stripping
27WT Air stripping
28WT Steam stripping
29WT Other stripping

Evaporation
30WT Thermal
31WT Solar
32WT Vapor recompression
33WT Other evaporation

Filtration
34WT Diatomaceous earth
35WT Sand
36WT Multimedia
37WT Other filtration

Sludge dewatering
38WT Gravity thickening
39WT Vacuum filtration
40WT Pressure filtration (belt, plate and frame, or leaf)
41WT Centrifuge
42WT Other sludge dewatering

Air flotation
43WT Dissolved air flotation
44WT Partial aeration
45WT Air dispersion
46WT Other air flotation

Oil skimming
47WT Gravity separation
48WT Coalescing plate separation
49WT Other oil skimming

Other liquid phase separation
50WT Decanting
51WT Other liquid phase separation

Biological treatment
52WT Activated sludge
53WT Fixed film-trickling filter
54WT Fixed film-rotating contactor
55WT Lagoon or basin, aerated
56WT Lagoon, facultative
57WT Anaerobic
58WT Other biological treatment

Other wastewater treatment
59WT Wet air oxidation
60WT Neutralization
61WT Nitrification
62WT Denitrification
63WT Flocculation and/or coagulation
64WT Settling (clarification)
65WT Reverse osmosis
66WT Other wastewater treatment

OTHER WASTE TREATMENT

1TR Other treatment
2TR Other recovery for reuse

ACCUMULATION

1A Containers
2A Tanks

STORAGE

1ST Container (i.e., barrel, drum)
2ST Tank
3ST Waste pile
4ST Surface impoundment
5ST Other storage

DISPOSAL

1D Landfill
2D Land treatment
3D Surface impoundment (to be closed as a landfill)
4D Underground injection well

---

[1]Chemical precipitation is a treatment operation whereby the pH of a waste is adjusted to the range necessary for removal (precipitation) of contaminants. However, if the pH is adjusted solely to achieve a neutral pH, THE OPERATION SHOULD BE CONSIDERED NEUTRALIZATION (60WT).

8.22 Describe the combustion chamber design parameters for each of the three largest (by capacity) incinerators that are used on-site to burn the residuals identified in your process block or residual treatment block flow diagram(s).

CBI

[ ]

Incinerator	Combustion Chamber Temperature (°C)		Location of Temperature Monitor		Residence Time In Combustion Chamber (seconds)	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
1	Not required for TDI					
2						
3						

Indicate if Office of Solid Waste survey has been submitted in lieu of response by circling the appropriate response.

Yes 1

No 2

8.23 Complete the following table for the three largest (by capacity) incinerators that are used on-site to burn the residuals identified in your process block or residual treatment block flow diagram(s).

CBI

[ ]

Incinerator	Air Pollution Control Device[1]	Types of Emissions Data Available
1	N/A	
2		
3		

Indicate if Office of Solid Waste survey has been submitted in lieu of response by circling the appropriate response.

Yes 1

No 2

[1] Use the following codes to designate the air pollution control device:

S = Scrubber (include type of scrubber in parenthesis)
E = Electrostatic precipitator
O = Other (specify) _____

[ ] Mark (X) this box if you attach a continuation sheet.

SECTION 9 WORKER EXPOSURE

General Instructions:

Questions 9.03-9.25 apply only to those processes and workers involved in manufacturing or processing the listed substance. Do not include workers involved in residual waste treatment unless they are involved in this treatment process on a regular basis (i.e., exclude maintenance workers, construction workers, etc.).

[ ] Mark (X) this box if you attach a continuation sheet.

PART A EMPLOYMENT AND POTENTIAL EXPOSURE PROFILE

9.01 Mark (X) the appropriate column to indicate whether your company maintains records on the following data elements for hourly and salaried workers. Specify for each data element the year in which you began maintaining records and the number of years the CBI records for that data element are maintained. (Refer to the instructions for further explanation and an example.)

[ ]

Data Element	Data are Maintained for: Hourly Workers	Salaried Workers	Year in Which Data Collection Began	Number of Years Records Are Maintained
Date of hire	X	X	1970	Length of employment + 30
Age at hire	X	X	1970	" "
Work history of individual before employment at your facility				
Sex	X	X	1970	" "
Race	X	X	1970	" "
Job titles	X	X	1970	" "
Start date for each job title	X	X	1970	" "
End date for each job title	X	X	1970	" "
Work area industrial hygiene monitoring data	X		1970	" "
Personal employee monitoring data	X		1970	" "
Employee medical history	X	X	1970	" "
Employee smoking history				
Accident history				
Retirement date	X	X	1970	" "
Termination date	X	X	1970	" "
Vital status of retirees				
Cause of death data				

[ ] Mark (X) this box if you attach a continuation sheet.

9.02 In accordance with the instructions, complete the following table for each activity in which you engage.

CBI

[ ]

a. Activity	b. Process Category	c. Yearly Quantity (kg)	d. Total Workers	e. Total Worker-Hours
Manufacture of the listed substance	Enclosed	N/A	N/A	N/A
	Controlled Release	N/A	N/A	N/A
	Open	N/A	N/A	N/A
On-site use as reactant	Enclosed	N/A	N/A	N/A
	Controlled Release	63,000	8	15,680
	Open	N/A	N/A	N/A
On-site use as nonreactant	Enclosed	N/A	N/A	N/A
	Controlled Release	N/A	N/A	N/A
	Open	N/A	N/A	N/A
On-site preparation of products	Enclosed	N/A	N/A	N/A
	Controlled Release	N/A	N/A	N/A
	Open	N/A	N/A	N/A

[ ] Mark (X) this box if you attach a continuation sheet.

9.03 **Provide a descriptive job title for each labor category at your facility that encompasses workers who may potentially come in contact with or be exposed to the listed substance.**

CBI

[ ]

Labor Category	Descriptive Job Title
A	Foreman
B	Group Leader
C	Automatic Foam Machine Operator
D	1st Class assembler
E	Utility operator
F	
G	
H	
I	
J	

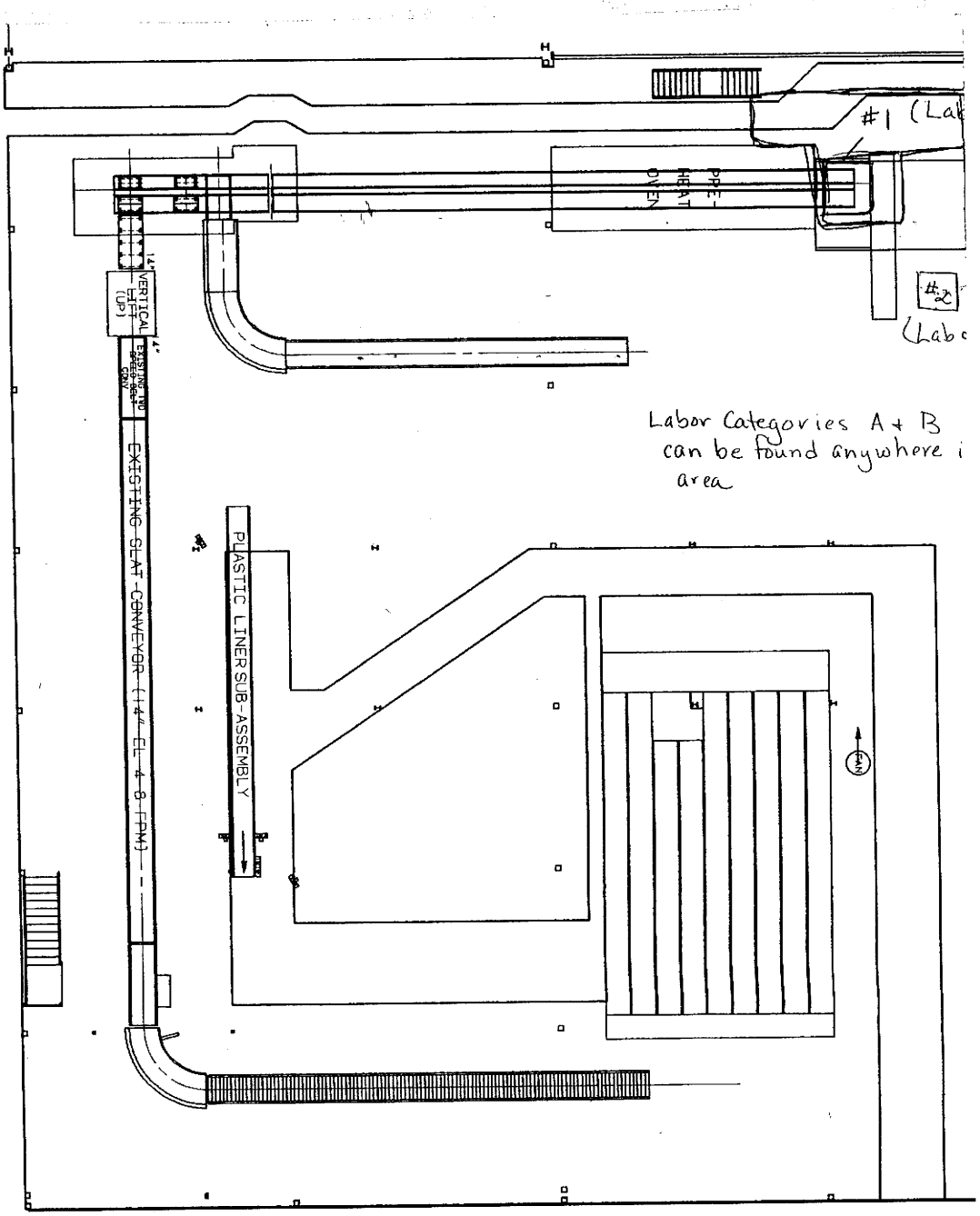
[ ] Mark (X) this box if you attach a continuation sheet.

9.04 **In accordance with the instructions, provide your process block flow diagram(s) and indicate associated work areas.**

CBI

[ ] **Process type .....** Polyurethane foam insulation manufacturing

[X] **Mark (X) this box if you attach a continuation sheet.**



Labor Categories A + B can be found anywhere i area

Attachment 5

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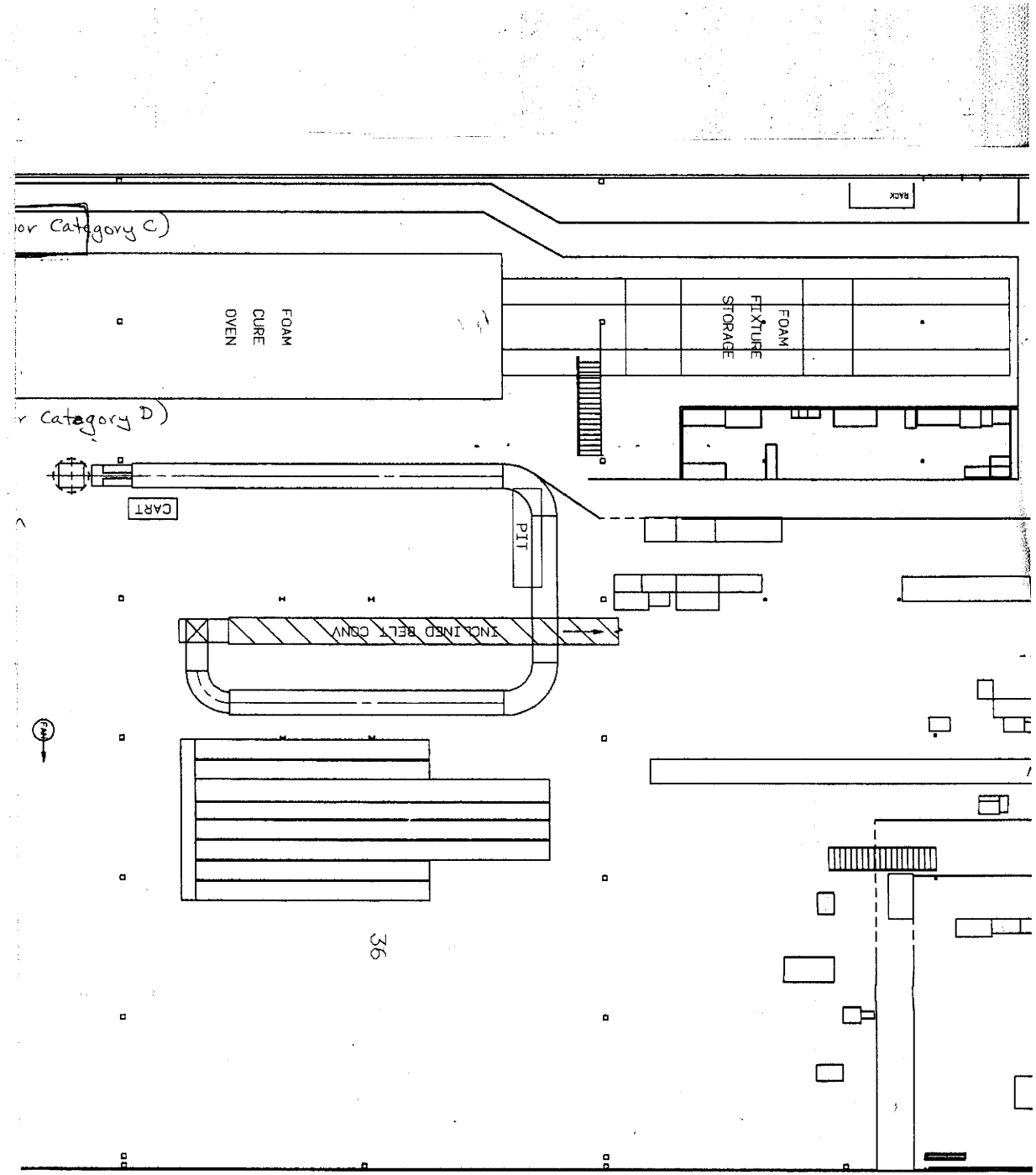
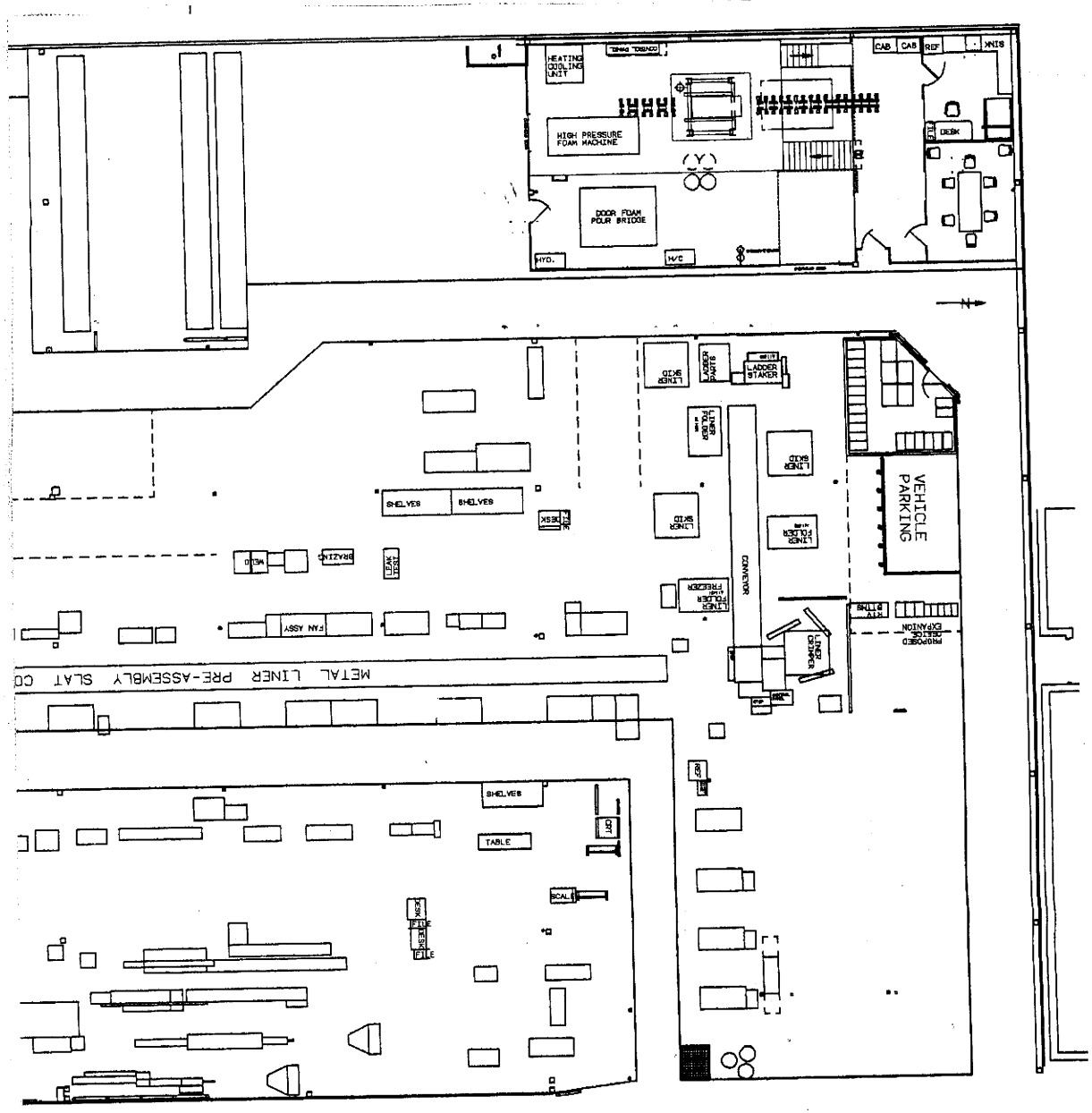
DATE= 6/30/89 TIME=11.31 ACCESS=NONE
LOGON ID=SMYE



01071T277 LAST FILE=89181 10:59 FILE: VRFOUT DATA A AMANA REFRIGERATION, INC.
FMT=4001D


HEATING COOLING UNIT
HIGH PRESSURE FOAM MACHINE
DOOR FOAM POUR BRIDGE
H/C
HYD.
CAB
CAB
REF
SINK
DESK
LINER SKID
LADDER STAKER
VEHICLE PARKING
SHELVES
SHELVES
DESK
WELD
BRAZING
LEAK TEST
FAN ASSY
METAL LINER PRE-ASSEMBLY SLAT CO
CONVEYOR
SHELVES
TABLE
SCALE
DESK

9.05 Describe the various work area(s) shown in question 9.04 that encompass workers who may potentially come in contact with or be exposed to the listed substance. Add any additional areas not shown in the process block flow diagram in question 7.01 or 7.02. Photocopy this question and complete it separately for each process type.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Work Area ID	Description of Work Areas and Worker Activities
1	Foam fixture loading; foam machine operation & calibration
2	Foam fixture unloading
3	
4	
5	
6	
7	
8	
9	
10	

[ ] Mark (X) this box if you attach a continuation sheet.

9.06 Complete the following table for each work area identified in question 9.05, and for each labor category at your facility that encompasses workers who may potentially come in contact with or be exposed to the listed substance. Photocopy this question and complete it separately for each process type and work area.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 1

Labor Category	Number of Workers Exposed	Mode of Exposure (e.g., direct skin contact)	Physical State of Listed Substance[1]	Average Length of Exposure Per Day[2]	Number of Days per Year Exposed
A	2	Skin contact/ inhalation	GU/OL	A	245
B	2	Skin contact/ inhalation	GU/OL	A	245
C	1	Skin contact/ inhalation	GU/OL	E	245
E	1	Skin contact/ inhalation	GU/OL	C	245

[1]Use the following codes to designate the physical state of the listed substance at the point of exposure:

GC = Gas (condensible at ambient temperature and pressure)
GU = Gas (uncondensible at ambient temperature and pressure; includes fumes, vapors, etc.)
SO = Solid
SY = Sludge or slurry
AL = Aqueous liquid
OL = Organic liquid
IL = Immiscible liquid (specify phases, e.g., 90% water, 10% toluene)

[2]Use the following codes to designate average length of exposure per day:

A = 15 minutes or less
B = Greater than 15 minutes, but not exceeding 1 hour
C = Greater than one hour, but not exceeding 2 hours
D = Greater than 2 hours, but not exceeding 4 hours
E = Greater than 4 hours, but not exceeding 8 hours
F = Greater than 8 hours

[X] Mark (X) this box if you attach a continuation sheet.

9.06 Complete the following table for each work area identified in question 9.05, and for each labor category at your facility that encompasses workers who may potentially come in contact with or be exposed to the listed substance. Photocopy this question and complete it separately for each process type and work area.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 2

Labor Category	Number of Workers Exposed	Mode of Exposure (e.g., direct skin contact)	Physical State of Listed Substance[1]	Average Length of Exposure Per Day[2]	Number of Days per Year Exposed
A	2	Skin contact/ inhalation	GU/OL	A	245
B	2	Skin contact/ inhalation	GU/OL	A	245
D	1	Skin contact/ inhalation	GU/OL	E	245

[1]Use the following codes to designate the physical state of the listed substance at the point of exposure:

GC = Gas (condensible at ambient temperature and pressure)
GU = Gas (uncondensible at ambient temperature and pressure; includes fumes, vapors, etc.)
SO = Solid
SY = Sludge or slurry
AL = Aqueous liquid
OL = Organic liquid
IL = Immiscible liquid (specify phases, e.g., 90% water, 10% toluene)

[2]Use the following codes to designate average length of exposure per day:

A = 15 minutes or less
B = Greater than 15 minutes, but not exceeding 1 hour
C = Greater than one hour, but not exceeding 2 hours
D = Greater than 2 hours, but not exceeding 4 hours
E = Greater than 4 hours, but not exceeding 8 hours
F = Greater than 8 hours

[ ] Mark (X) this box if you attach a continuation sheet.

9.07 For each labor category represented in question 9.06, indicate the 8-hour Time Weighted Average (TWA) exposure levels and the 15-minute peak exposure levels. Photocopy this question and complete it separately for each process type and work area.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 1

Labor Category	8-hour TWA Exposure Level (ppm, mg/m^3, other-specify)	15-Minute Peak Exposure Level (ppm, mg/m^3, other-specify)
A	UK	UK
B	UK	UK
C	0.0025PPM	---
E	--	0-15 PPB*

The above data was not obtained exclusively during the reporting year, but is believed to be representative of exposures during that time.

* This is area monitoring during the calibration process. It does not represent personal samples.

[X] Mark (X) this box if you attach a continuation sheet.

9.07 **For each labor category represented in question 9.06, indicate the 8-hour Time Weighted Average (TWA) exposure levels and the 15-minute peak exposure levels. Photocopy this question and complete it separately for each process type and work area.**

CBI

[ ] **Process type .....** Polyurethane foam insulation manufacturing

Work area ..... Number 2

Labor Category	8-hour TWA Exposure Level (ppm, mg/m^3, other-specify)	15-Minute Peak Exposure Level (ppm, mg/m^3, other-specify)
A	UK	UK
B	UK	UK
D	0.002 PPM	--

The above data was not obtained exclusively during the reporting year, but is believed to be representative of exposures during that time.

[ ] **Mark (X) this box if you attach a continuation sheet.**

9.09 For each sample type identified in question 9.08, describe the type of sampling and analytical methodology used for each type of sample.

CBI

[ ]

Sample Type	Sampling and Analytical Methodology
Personal sample (ceiling determination)	GMD Systems Surespot Badge; paper tape, color change comparison
Area sample (continuous)	GMD Systems Autostep 920; direct reading monitor (paper type)
Operator breathing zone (OBZ) + other areas (continuous)	Midget impinger, TDI reagent, high performance liquid chromatography (HPLC)
Personal sample (continuous)	MDA MCM-4000 personal sampler (paper tape)
OBZ + other areas (continuous)	MDA MCM-4000; GMD Autostep 920; TDI reagent/HPLC

9.10 If you conduct personal and/or ambient air monitoring for the listed substance, specify the following information for each equipment type used.

CBI

[ ]

Equipment Type[1]	Detection Limit[2]	Manufacturer	Averaging Time (hr)	Model Number
H	1 ppb	GMD Systems, Inc.	0.0067 0.0667	920
A	20 ppb (15 min)	GMD Systems, Inc.	0.25	550 Series Sure-Spot

[1]Use the following codes to designate personal air monitoring equipment types:

A = Passive dosimeter
B = Detector tube
C = Charcoal filtration tube with pump
D = Other (specify) _____

Use the following codes to designate ambient air monitoring equipment types:

E = Stationary monitors located within work area
F = Stationary monitors located within facility
G = Stationary monitors located at plant boundary
H = Mobile monitoring equipment (specify) Autostep Model 920
I = Other (specify) _____

[2]Use the following codes to designate detection limit units:

A = ppm
B = Fibers/cubic centimeter (f/cc)
C = Micrograms/cubic meter (μ/m^3)

[X] Mark (X) this box if you attach a continuation sheet.

PART B WORK PLACE MONITORING PROGRAM

9.08 If you monitor worker exposure to the listed substance, complete the following table.

CBI

[ ]

Sample/Test	Work Area ID	Testing Frequency (per year)	Number of Samples (per test)	Who Samples[1]	Analyzed In-House (Y/N)	Number of Years Records Maintained
Personal breathing zone	32"	0-2	1-2	A,B,D	N	30+ yrs
General work area (air)	32" Line 8	0-6	1-30	A,B,D	N	30+ yrs
Wipe samples	N/A					
Adhesive patches	N/A					
Blood samples	N/A					
Urine samples	N/A					
Respiratory samples	N/A					
Allergy tests	N/A					
Other (specify)						
Other (specify)						
Other (specify)						

[1]Use the following codes to designate who takes the monitoring samples:

A = Plant industrial hygienist
B = Insurance carrier
C = OSHA consultant
D = Other (specify) IH from manufacturer; OSHA inspector

[ ] Mark (X) this box if you attach a continuation sheet.

9.09 For each sample type identified in question 9.08, describe the type of sampling and analytical methodology used for each type of sample.

CBI

[ ]	Sample Type	Sampling and Analytical Methodology
	Area samples (continuous)	MDA Scientific Model 7000 TDI detector (paper tape)
	Area samples (short term)	Belisle colorimetric method
	Area samples (short term)	Marcali method

9.10 If you conduct personal and/or ambient air monitoring for the listed substance, specify the following information for each equipment type used.

CBI

[ ]	Equipment Type[1]	Detection Limit[2]	Manufacturer	Averaging Time (hr)	Model Number

[1]Use the following codes to designate personal air monitoring equipment types:

A = Passive dosimeter
B = Detector tube
C = Charcoal filtration tube with pump
D = Other (specify) _____

Use the following codes to designate ambient air monitoring equipment types:

E = Stationary monitors located within work area
F = Stationary monitors located within facility
G = Stationary monitors located at plant boundary
H = Mobile monitoring equipment (specify) _____
I = Other (specify) _____

[2]Use the following codes to designate detection limit units:

A = ppm
B = Fibers/cubic centimeter (f/cc)
C = Micrograms/cubic meter (μ/m^3)

[ ] Mark (X) this box if you attach a continuation sheet.

9.11 If you conduct routine medical tests for monitoring the health effects of exposure to the listed substance, specify the type and frequency of the tests.

CBI

[ ]	Test Description	Frequency (weekly, monthly, yearly, etc.)
	None	

[ ] Mark (X) this box if you attach a continuation sheet.

PART C ENGINEERING CONTROLS

9.12 Describe the engineering controls that you use to reduce or eliminate worker exposure to the listed substance. Photocopy this question and complete it separately for each process type and work area.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 1

Engineering Controls	Used (Y/N)	Year Installed	Upgraded (Y/N)	Year Upgraded
Ventilation:				
Local exhaust	Y	1973	Y	1984
General dilution	Y	1973	N	
Other (specify)				
Vessel emission controls				
Mechanical loading or packaging equipment				
Other (specify)				

[X] Mark (X) this box if you attach a continuation sheet.

PART C ENGINEERING CONTROLS

9.12 Describe the engineering controls that you use to reduce or eliminate worker exposure to the listed substance. Photocopy this question and complete it separately for each process type and work area.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 2

Engineering Controls	Used (Y/N)	Year Installed	Upgraded (Y/N)	Year Upgraded
Ventilation:				
Local exhaust				
General dilution	Y	UK	N	---
Other (specify)				
Vessel emission controls				
Mechanical loading or packaging equipment				
Other (specify)				

[ ] Mark (X) this box if you attach a continuation sheet.

9.13 **Describe all equipment or process modifications you have made within the 3 years prior to the reporting year that have resulted in a reduction of worker exposure to the listed substance. For each equipment or process modification described, state the percentage reduction in exposure that resulted. Photocopy this question and complete it separately for each process type and work area.**

CBI

[ ] **Process type .....** Polyurethane foam insulation manufacturing

Work area ..... Number 1

Equipment or Process Modification	Reduction in Worker Exposure Per Year (%)
Raw material substitution	307.3*

* Actual production drop in units. We do not have monitoring data to determine if there has been a corresponding reduction in exposure.

[X] **Mark (X) this box if you attach a continuation sheet.**

9.13 **Describe all equipment or process modifications you have made within the 3 years prior to the reporting year that have resulted in a reduction of worker exposure to the listed substance. For each equipment or process modification described, state the percentage reduction in exposure that resulted. Photocopy this question and complete it separately for each process type and work area.**

CBI

[ ] **Process type .....** Polurethane foam insulation manufacturing

Work area ..... Number 2

Equipment or Process Modification	Reduction in Worker Exposure Per Year (%)
Raw material substitution	307.3 *

* Actual production drop in units. We do not have monitoring data to determine if there has been a corresponding reduction in exposure.

[ ] **Mark (X) this box if you attach a continuation sheet.**

PART D PERSONAL PROTECTIVE AND SAFETY EQUIPMENT

9.14 Describe the personal protective and safety equipment that your workers wear or use in each work area in order to reduce or eliminate their exposure to the listed substance. Photocopy this question and complete it separately for each process type and work area.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 1

Equipment Types	Wear or Use (Y/N)
Respirators	N*
Safety goggles/glasses	Y
Face shields	N
Coveralls	Y
Bib aprons	N
Chemical-resistant gloves	N
Other (specify)	

* Monitoring results have indicated that respiratory protection is not required for operation of this process, however, respirators are worn for calibration of equipment, maintenance activities, and spill clean up.

[ ] Mark (X) this box if you attach a continuation sheet.

9.15 If workers use respirators when working with the listed substance, specify for each process type, the work areas where the respirators are used, the type of respirators used, the average usage, whether or not the respirators were fit tested, and the type and frequency of the fit tests. Photocopy this question and complete it separately for each process type.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Work Area	Respirator Type	Average Usage[1]	Fit Tested (Y/N)	Type of Fit Test[2]	Frequency of Fit Tests (per year)
1	Air-purifying	A	Y	QL	1
	Supplied air (positive pressure)	D	N		
	Self-contained breathing apparatus (SCBA)	E	N		

[1]Use the following codes to designate average usage:

A = Daily
B = Weekly
C = Monthly
D = Once a year
E = Other (specify) during spill cleanup

[2]Use the following codes to designate the type of fit test:

QL = Qualitative
QT = Quantitative

As in 9.14, respirators are only worn for calibration (air-purifying), maintenance (supplied air), and spill cleanup (SCBA). The last two activities could occur anywhere in the area.

[ ] Mark (X) this box if you attach a continuation sheet.

PART E WORK PRACTICES

9.19 Describe all of the work practices and administrative controls used to reduce or eliminate worker exposure to the listed substance (e.g., restrict entrance only to authorized workers, mark areas with warning signs, insure worker detection and monitoring practices, provide worker training programs, etc.). Photocopy this CBI question and complete it separately for each process type and work area.

[ ]

Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 1

Restricted access to area; warning signs posted (NFPA); hazard communications are used to reduce or eliminate routine worker exposure. Engineering controls have been installed to prevent spills.

9.20 Indicate (X) how often you perform each housekeeping task used to clean up routine leaks or spills of the listed substance. Photocopy this question and complete it separately for each process type and work area.

Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 1

Housekeeping Tasks	Less Than Once Per Day	1-2 Times Per Day	3-4 Times Per Day	More Than 4 Times Per Day
Sweeping	X			
Vacuuming				
Water flushing of floors				
Other (specify)				
Drip pan cleanup		X		

Because we do not experience routine spills, we cannot provide frequencies for the housekeeping tasks for spills. When a spill does occur, a neutralization solution is used to flush the area and the liquid is absorbed.

[X] Mark (X) this box if you attach a continuation sheet.

PART E WORK PRACTICES

9.19 Describe all of the work practices and administrative controls used to reduce or eliminate worker exposure to the listed substance (e.g., restrict entrance only to authorized workers, mark areas with warning signs, insure worker detection and monitoring practices, provide worker training programs, etc.). Photocopy this CBI question and complete it separately for each process type and work area.

[ ]

Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 2

Restricted access to area; warning signs posted (NFPA); hazard communications are used to reduce or eliminate routine worker exposure. Engineering controls have been installed to prevent spills.

9.20 Indicate (X) how often you perform each housekeeping task used to clean up routine leaks or spills of the listed substance. Photocopy this question and complete it separately for each process type and work area.

Process type ..... Polyurethane foam insulation manufacturing

Work area ..... Number 2

Housekeeping Tasks	Less Than Once Per Day	1-2 Times Per Day	3-4 Times Per Day	More Than 4 Times Per Day
Sweeping	X			
Vacuuming				
Water flushing of floors				
Other (specify)				
Drip pan cleanup		X		

Because we do not experience routine spills, we cannot provide frequencies for the housekeeping tasks for spills. When a spill does occur, a neutralization solution is used to flush the area and the liquid is absorbed.

[ ] Mark (X) this box if you attach a continuation sheet.

9.21 Do you have a written medical action plan for responding to routine or emergency exposure to the listed substance?

Routine exposure

Yes ... MSDS represents written medical action plan ... 1

No ... 2

Emergency exposure

Yes ... MSDS represents written medical action plan ... 1

No ... 2

If yes, where are copies of the plan maintained?

Routine exposure: Human Resources - First Aid

Emergency exposure: Human Resources - First Aid

9.22 Do you have a written leak and spill cleanup plan that addresses the listed substance? Circle the appropriate response.

Yes ... 1

No ... 2

If yes, where are copies of the plan maintained? Human Resources

Has this plan been coordinated with state or local government response organizations? Circle the appropriate response.

Yes ... 1

No ... 2

9.23 Who is responsible for monitoring worker safety at your facility? Circle the appropriate response.

Plant safety specialist . Director, Occupational Safety ... 1

Insurance carrier ... 2

OSHA consultant ... 3

Other (specify) Director, Occupational Health ... 4

[ ] Mark (X) this box if you attach a continuation sheet.

SECTION 10 ENVIRONMENTAL RELEASE

General Instructions:

Complete Part E (questions 10.23-10.35) for each non-routine release involving the listed substance that occurred during the reporting year. Report on all releases that are equal to or greater than the listed substance's reportable quantity value, RQ, unless the release is federally permitted as defined in 42 U.S.C. 9601, or is specifically excluded under the definition of release as defined in 40 CFR 302.3(22). Reportable quantities are codified in 40 CFR Part 302. If the listed substance is not a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and, thus, does not have an RQ, then report releases that exceed 2,270 kg. If such a substance however, is designated as a CERCLA hazardous substance, then report those releases that are equal to or greater than the RQ. The facility may have answered these questions or similar questions under the Agency's Accidental Release Information Program and may already have this information readily available. Assign a number to each release and use this number throughout this part to identify the release. Releases over more than a 24-hour period are not single releases, i.e., the release of a chemical substance equal to or greater than an RQ must be reported as a separate release for each 24-hour period the release exceeds the RQ.

For questions 10.25-10.35, answer the questions for each release identified in question 10.23. Photocopy these questions and complete them separately for each release.

PART A GENERAL INFORMATION

10.01 Where is your facility located? Circle all appropriate responses.

CBI

[ ]	Industrial area	1
	Urban area	2
	Residential area	(X)
	Agricultural area	(X)
	Rural area	(X)
	Adjacent to a park or a recreational area	(X)
	Within 1 mile of a navigable waterway	(X)
	Within 1 mile of a school, university, hospital, or nursing home facility	(X)
	Within 1 mile of a non-navigable waterway	(X)
	Other (specify) _____	10

[ ] Mark (X) this box if you attach a continuation sheet.

10.02 Specify the exact location of your facility (from central point where process unit is located) in terms of latitude and longitude or Universal Transverse Mercader (UTM) coordinates.

Latitude ..... 41 ° 47 ' 22 "

Longitude ..... 90 ° 53 ' 49 "

UTM coordinates ..... Zone _____, Northing _____, Easting _____

10.03 If you monitor meteorological conditions in the vicinity of your facility, provide the following information.

Average annual precipitation ..Not required for TDI. _____ inches/year

Predominant wind direction ..... _____

10.04 Indicate the depth to groundwater below your facility.

Depth to groundwater ...Not required for TDI..... _____ meters

10.05 For each on-site activity listed, indicate (Y/N/NA) all routine releases of the listed substance to the environment. (Refer to the instructions for a definition of Y, N, and NA.)

CBI

[__]

On-Site Activity	Environmental Release		
	Air	Water	Land
Manufacturing	N/A	N/A	N/A
Importing	N/A	N/A	N/A
Processing	Y	N	N
Otherwise used	N/A	N/A	N/A
Product or residual storage	Y	N	N
Disposal	N/A	N/A	N/A
Transport	N	N	N

[__] Mark (X) this box if you attach a continuation sheet.

10.06 Provide the following information for the listed substance and specify the level of precision for each item. (Refer to the instructions for further explanation and an example.)

CBI

[ ]

Quantity discharged to the air	3	kg/yr ± UK	%
Quantity discharged in wastewaters	0	kg/yr ±	%
Quantity managed as other waste in on-site treatment, storage, or disposal units	0	kg/yr ±	%
Quantity managed as other waste in off-site treatment, storage, or disposal units	8200	kg/yr ± 5	%

* Air discharge is based on discharge of 50 lbs/million lbs processed as determined by a West German study.

[ ] Mark (X) this box if you attach a continuation sheet.

10.08 Describe the control technologies used to minimize release of the listed substance for each process stream containing the listed substance as identified in your process block or residual treatment block flow diagram(s). Photocopy this question and complete it separately for each process type.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Stream ID Code	Control Technology	Percent Efficiency
	None	

[ ] Mark (X) this box if you attach a continuation sheet.

PART B RELEASE TO AIR

10.09 Point Source Emissions -- Identify each emission point source containing the listed substance in terms of a Stream ID Code as identified in your process block or residual treatment block flow diagram(s), and provide a description of each point source. Do not include raw material and product storage vents, or fugitive emission sources (e.g., equipment leaks). Photocopy this question and complete it separately for each process type.

CBI
[ ]

Process type ..... Polyurethane foam insulation manufacturing

Point Source ID Code	Description of Emission Point Source
MH1/MH2	32" foam oven

[ ] Mark (X) this box if you attach a continuation sheet.

[ ] Mark (X) this box if you attach a continuation sheet.

10.10 Emission Characteristics - - Characterize the emissions for each Point Source ID Code identified in question 10.09 by completing the following table.

CBI

[ ]

Point Source ID Code	Physical State[1]	Average Emissions (kg/day)	Frequency[2] (days/yr)	Duration[3] (min/day)	Average Emission Factor[4]	Maximum Emission Rate (kg/min)	Maximum Emission Rate Frequency (events/yr)	Maximum Emission Rate Duration (min/event)
MH1/MH2	V	0	230	480	0	0	230	480

[1]Use the following codes to designate physical state at the point of release:
G = Gas; V = Vapor; P = Particulate; A = Aerosol; O = Other (specify) G

[2]Frequency of emission at any level of emission

[3]Duration of emission at any level of emission

[4]Average Emission Factor — Provide estimated (± 25 percent) emission factor (kg of emission per kg of production of listed substance)

* Emissions from this process of the subject chemical are so low that with our relatively low usage all emissions are essentially zero.

10.11 Stack Parameters -- Identify the stack parameters for each Point Source ID Code identified in question 10.09 by completing the following table.

CBI

[ ]

Point Source ID Code	Stack Height(m)	Stack Inner Diameter (at outlet) (m)	Exhaust Temperature (°C)	Emission Exit Velocity (m/sec)	Building Height(m)[1]	Building Width(m)[2]	Vent Type[3]
MH1/MH2	1.3*	.5	UK	UK	13m	43m	V

[1]Height of attached or adjacent building

[2]Width of attached or adjacent building

[3]Use the following codes to designate vent type:

H = Horizontal
V = Vertical

* above building roof

[ ] Mark (X) this box if you attach a continuation sheet.

10.12 If the listed substance is emitted in particulate form, indicate the particle size distribution for each Point Source ID Code identified in question 10.09. Photocopy this question and complete it separately for each emission point source.

CBI

[ ]

Point source ID code ..... Not applicable to TDI

Size Range (microns)	Mass Fraction (% ± % precision)
< 1	
≥ 1 to < 10	
≥ 10 to < 30	
≥ 30 to < 50	
≥ 50 to < 100	
≥ 100 to < 500	
≥ 500	

Total = 100%

[ ] Mark (X) this box if you attach a continuation sheet.

PART C FUGITIVE EMISSIONS

10.13 Equipment Leaks -- Complete the following table by providing the number of equipment types listed which are exposed to the listed substance and which are in service according to the specified weight percent of the listed substance passing through the component. Do this for each process type identified in your process block or residual treatment block flow diagram(s). Do not include equipment types that are not exposed to the listed substance. If this is a batch or intermittently operated process, give an overall percentage of time per year that the process type is exposed to the listed substance. Photocopy this question and complete it separately for each process type.

CBI

[ ] Process type ..... Polyurethane foam insulation manufacturing

Percentage of time per year that the listed substance is exposed to this process type ..... 100 %

Equipment Type	Number of Components in Service by Weight Percent of Listed Substance in Process Stream					
	Less than 5%	5-10%	11-25%	26-75%	76-99%	Greater than 99%
Pump seals[1]						
Packed	N/A	N/A	N/A	0	N/A	N/A
Mechanical	N/A	N/A	N/A	0	N/A	N/A
Double mechanical[2]	N/A	N/A	N/A	4	N/A	N/A
Compressor seals[1]	N/A	N/A	N/A	0	N/A	N/A
Flanges	N/A	N/A	N/A	27	N/A	N/A
Valves						
Gas[3]	N/A	N/A	N/A	0	N/A	N/A
Liquid	N/A	N/A	N/A	16	N/A	N/A
Pressure relief devices[4] (Gas or vapor only)	N/A	N/A	N/A	5	N/A	N/A
Sample connections						
Gas	N/A	N/A	N/A	0	N/A	N/A
Liquid	N/A	N/A	N/A	4	N/A	N/A
Open-ended lines[5] (e.g., purge, vent)						
Gas	N/A	N/A	N/A	0	N/A	N/A
Liquid	N/A	N/A	N/A	0	N/A	N/A

[1]List the number of pump and compressor seals, rather than the number of pumps or compressors

10.13 continued on next page

[ ] Mark (X) this box if you attach a continuation sheet.

10.13 (continued)

[2]If double mechanical seals are operated with the barrier (B) fluid at a pressure greater than the pump stuffing box pressure and/or equipped with a sensor (S) that will detect failure of the seal system, the barrier fluid system, or both, indicate with a "B" and/or an "S", respectively

[3]Conditions existing in the valve during normal operation

[4]Report all pressure relief devices in service, including those equipped with control devices

[5]Lines closed during normal operation that would be used during maintenance operations

10.14 Pressure Relief Devices with Controls -- Complete the following table for those pressure relief devices identified in 10.13 to indicate which pressure relief devices in service are controlled. If a pressure relief device is not controlled, enter "None" under column c.

CBI

[ ]

a. Number of Pressure Relief Devices	b. Percent Chemical in Vessel[1]	c. Control Device	d. Estimated Control Efficiency[2]
None			

[1]Refer to the table in question 10.13 and record the percent range given under the heading entitled "Number of Components in Service by Weight Percent of Listed Substance" (e.g., <5%, 5-10%, 11-25%, etc.)

[2]The EPA assigns a control efficiency of 100 percent for equipment leaks controlled with rupture discs under normal operating conditions. The EPA assigns a control efficiency of 98 percent for emissions routed to a flare under normal operating conditions

[ ] Mark (X) this box if you attach a continuation sheet.

10.15 Equipment Leak Detection -- If a formal leak detection and repair program is in place, complete the following table regarding those leak detection and repair procedures. Photocopy this question and complete it separately for each process type.

CBI

[ ] Process type ..... Not applicable - no formal program

Equipment Type	Leak Detection Concentration (ppm or mg/m^3) Measured at ____ Inches from Source	Detection Device[1]	Frequency of Leak Detection (per year)	Repairs Initiated (days after detection)	Repairs Completed (days after initiated)
Pump seals					
Packed					
Mechanical					
Double mechanical					
Compressor seals					
Flanges					
Valves					
Gas					
Liquid					
Pressure relief devices (gas or vapor only)					
Sample connections					
Gas					
Liquid					
Open-ended lines					
Gas					
Liquid					

[1]Use the following codes to designate detection device:

POVA = Portable organic vapor analyzer
FPM = Fixed point monitoring
O = Other (specify) _____

[ ] Mark (X) this box if you attach a continuation sheet.

10.16 Raw Material, Intermediate and Product Storage Emissions - - Complete the following table by providing the information on each liquid raw material, intermediate, and product storage vessel containing the listed substance as identified in your process block or residual treatment block flow diagram(s).

CBI

[ ] Mark (X) this box if you attach a continuation sheet.

Vessel Type[1]	Floating Roof Seals[2]	Composition of Stored Materials[3]	Throughput (liters per year)	Vessel Filling Rate (gpm)	Vessel Filling Duration (min)	Vessel Inner Diameter (m)	Vessel Height (m)	Operating Vessel Volume (l)	Vessel Emission Controls[4]	Design Flow Rate[5]	Vent Diameter (cm)	Control Efficiency (%)	Basis for Estimate[6]
P (15 psig)	MS2	60%(UK)	50,000	60	75	3	4	30,280	pressure relief valve	10 psig	10cm	100%*	C
P (15 psig)	LM2	60%(UK)	50,000	**	**	.75	.75	380	balance line to storage	--	--	---	---

[1]Use the following codes to designate vessel type:

F = Fixed roof
CIF = Contact internal floating roof
NCIF = Noncontact internal floating roof
EFR = External floating roof
P = Pressure vessel (indicate pressure rating)
H = Horizontal
U = Underground

[2]Use the following codes to designate floating roof seals:

MS1 = Mechanical shoe, primary
MS2 = Shoe-mounted secondary
MS2R = Rim-mounted, secondary
LM1 = Liquid-mounted resilient filled seal, primary
LM2 = Rim-mounted shield
LMW = Weather shield
VM1 = Vapor mounted resilient filled seal, primary
VM2 = Rim-mounted secondary
VMW = Weather shield

* if pressure doesn't exceed 10 there is zero emission

** process day tank in recirc. line

[3]Indicate weight percent of the listed substance. Include the total volatile organic content in parenthesis

[4]Other than floating roofs

[5]Gas/vapor flow rate the emission control device was designed to handle (specify flow rate units)

[6]Use the following codes to designate basis for estimate of control efficiency:

C = Calculations
S = Sampling

PART E NON-ROUTINE RELEASES

10.23 Indicate the date and time when the release occurred and when the release ceased or was stopped. If there were more than six releases, attach a continuation sheet and list all releases.

Release	Date Started	Time (am/pm)	Date Stopped	Time (am/pm)
1	None			
2				
3				
4				
5				
6				

10.24 Specify the weather conditions at the time of each release.

Release	Wind Speed (km/hr)	Wind Direction	Humidity (%)	Temperature (°C) (Not required for TDI)	Precipitation (Y/N)
1					
2					
3					
4					
5					
6					

[ ] Mark (X) this box if you attach a continuation sheet.

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